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Illustrated articles are marked with an asterisk (*). Reviews of Books are marked with a dagger (†).

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Gottlieb Daimler

(Obiit March 6, 1900)

The Automobile
MAGAZINE

VOL. II APRIL 1900 NO. 1

The Father of the Automobile

By Edwin Emerson, Jr.

BY the death of Gottlieb Daimler, the celebrated German inventor and engineer, last month, the world has lost the guiding spirit and creator of modern automobilism. Daimler was a man who resurrected the crude principles employed in the earliest horseless carriages and infused into them a new life. Thus he is in truth the father of the modern automobile.

Daimler's great achievement was the invention of the gasoline and petroleum explosion motor, which, fifteen years ago, revolutionized the construction and industry of light mechanical motors. His cylindrical motor in upright V form immediately became known as the celebrated Daimler Motor. In various modified forms it has been applied to a great majority of all the various gasoline motors now in use in Europe and in America. Later, as a result of the collaboration of Europe's most famous automobile inventors, Daimler and Levassor, a new motor was devised, the so-called "Phœnix Daimler" which has achieved such startling success in French racing machines. Levassor adopted the sprocket and chain, but Daimler insisted upon the use of pulleys and belts for the speed changing gear, and of gearing in the transmission of power. Before the death of Levassor, it was agreed that the system which gave the best results would be adopted. Daimler's system carried the day.

Gottlieb Daimler began his career as a common mechanic. He was born at Schorndorf in Wurtemberg, on March 17, 1834. After leaving school, he worked as a mechanic in a tool factory

at Grafenstaden, in Alsace. In 1857 he had earned enough money to attend the Polytechnic Institute at Stuttgart. After his graduation there he went to England and France and there continued his studies for two years at several of the best known factories. On his return to Germany, he was employed as an assistant foreman in Geislingen and Reutlingen, but soon left these machine shops to become the foreman of a large machine factory at Carlsruhe. In 1872 he was entrusted with the installation and management of a new factory for the construction of gas motors at Deutz. Within the space of ten years Daimler transformed this factory into a huge establishment of world-wide renown. In conjunction with Dr. Otto he constructed the first gas motor of one hundred horse-power, which has since become celebrated as "Otto's Motor." In 1882 he left this concern and established a factory of his own. It was at this time that he aided the well-known Messrs. Crossley, in Manchester, in their first construction of gas motors which have since then achieved so prominent a place in England.

The first product of Daimler's new factory was a motor with a horizontal cylinder in which the gas was compressed before ignition. By means of a so-called amorce, ignition was produced in such a manner that the motor continued to work, even after the extinction of the amorce. The cylinder was cooled by air flanges. Next year Daimler constructed his first upright motor with a cylinder where all the constructive parts were contained in a tight case. In 1885 Daimler patented the first motor cycle with a motor on the rear wheel. By the end of the same year he was able to turn out his first practical motor carriage. The inventor's genius next turned to a construction of vertical motors for gas or petroleum to be used in launches. This invention achieved instant favor and soon became one of the most profitable products of the Daimler works. In 1887 Daimler patented a motor street car propelled over steel tracks by means of a single cylinder. Change of speed was provided by three pairs of interlocking wheels which could be shifted at will. This invention was exhibited by MM. Panhard and Levassor at the Paris Exposition of 1889, where it excited universal attention.

In all Gottlieb Daimler invented no less than fifteen different motors, all of which were patented by himself, and were turned to immediate practical use. In his personal character the German inventor was one of the most kindly and generous of men. This serves to explain the great friendship that sprang up between him and so many French automobilists. As Baudry de Saunier has told in his Petites Annales, Daimler's factory and private

laboratory at Cannstadt, during the last few years, came to be considered as the true Mecca of all the most progressive *chauffeurs,* and they drove there on their motor wagons from all parts of the continent.

The Hon. Evelyn Ellis, the pioneer of British automobilism, not long ago related this interesting episode of his personal relations with the German inventor. Herr Daimler came to visit him at Malvern, in England. Mr. Ellis' automobile, fitted, of course, with the Daimler engine, carried the inventor over a long drive from the station to the house. After luncheon a more extensive country drive was undertaken, but at the first hill the machine stopped. The combined experience of the inventor and the owner failed to make the motor start. Every known expedient having been tried in turn, Mr. Ellis turned away disgusted, but Herr Daimler gave his motor a slap with his open hand, as if to say, "Now, will you be good?" This slap shook off some soot which had settled on the inhalation pipe, and in a moment the motor was running perfectly. Subsequently Mr. Ellis purchased from Mr. Daimler two of his most perfected motor carriages and no less than six motor tricycles. He did this impelled solely by the personal magnetism of Gottlieb Daimler.

Daimler Fast Speed Autocar

Automobilism in Warfare

(From the British *Automotor Journal*)

EVERYONE knows how and where thirteen horses out of eighteen were killed at Tugela River. There are certain kinds of work for which horses will probably always be superior to engines of any kind; but in an incident like that of the loss of the guns at the battle of Tugela River, supposing the ground to allow of its use, a traction-engine and a wire rope would be invaluable.

Now that the marksman with the rifle has shown himself to be, in suitable country, so much more important a factor in war than had been supposed, it is the more necessary to use mechanical power in military operations whenever possible. The horse is an easy mark to hit and cannot easily be equipped with defensive armor. A train of armored wagons, or one armored wagon, pulled along the veldt by an armored traction-engine might be used in the same way as an armored railway train, and with much greater possibilities. In the case of a quick retreat being necessary the engine might abandon the wagons and carry off the men at its best pace; in case of a slow retreat or reconnaissance the armored truck would be of very great value, as has been proved on the railways in the present war.

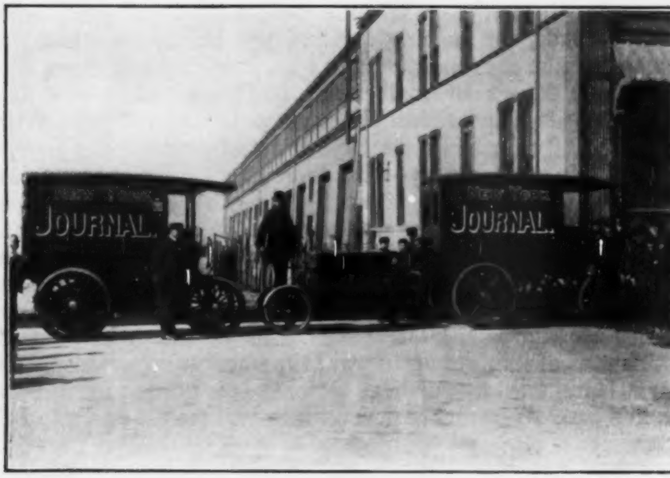
It is a truism that in modern warfare the advantage lies greatly with the defence, and any arrangement which permits of a *defensive attack* being made is worth carrying out, even at great cost and with great trouble.

The value of the traction-engine for transport in war has already been recognized even by our own military authorities, and a few have been sent out to South Africa; its possible value for moving guns and ammunition under fire seems to have been overlooked. " The guns then dashed across the zone of fire at great risk to men and horses and took up on a slight eminence a position which became a commanding one as soon as they got to work." The circumstance is ordinary enough, but suffices to indicate the usefulness of mechanical power in a battle.

A traction-engine might have to be abandoned in various emergencies, but it can go anywhere that heavy baggage trains can go. It is easily " spiked," if it has to be abandoned. It is not easily stampeded; does not suffer from " pink-eye." The cost of keeping an army in the field is so great that anything which expedites a victory is likely to be well worth paying for.

The motor field gun, with a certain amount of protective armor, has considerable possibilities before it—for scouting where there are roads, for pushing forward just before an infantry attack; in the last case the motor to be a powerful one, even if the gun is only a Maxim of small calibre, and the man or men to be as much protected as possible. This last point is an important one. It is frequently urged in the technical and professional Press—urged soberly and logically—that there is not sufficient protection in warships for the crews of our lighter guns, our machine guns and Maxims. The present war seems to indicate that more consideration ought to be paid to defensive armor in battles on land, especially for the side whose organization and resources are superior to that of the enemy, while their marksmanship and mobility are superior. The automobile is recognized on the Continent as of importance in war; the traction-engine also. The latter is being tried by our War Office. It is not too much to say that, in a modern form, the new century will see the revival of the war-chariot.

Auto Traction in the Transvaal



Automobiles for Newspaper Delivery

THE automobile is being used for carrying purposes in nearly all branches of business at the present time, but New York is the first city to use the electric wagon for the delivery of newspapers.

The New York *Journal* has now in use six electric wagons of the carrying capacity of 10,000 papers each, and more wagons will be added to its circulation department as they are built.

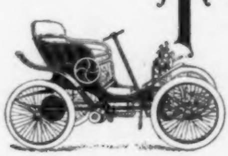
Circulation managers of the various American daily papers have struggled for years with the problem of "making" trains with their enormous quantities of mail and express matter each morning. On Sundays especially this problem is made twice difficult by the fact that there is no movement of mails and that express trains do not wait.

The hustle and bustle attending the issue of a great Sunday newspaper and the subsequent efforts of the circulation department to make, for example, the fast newspaper trains in twelve minutes from Park Row, is interesting.

The Electric Vehicle Company, of New York, are the manufacturers of the electric newspaper delivery wagons.

The Light Road Carriage

By Edward de Nôreme

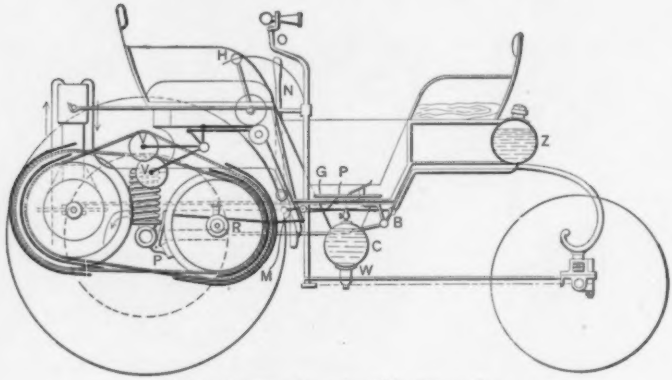


THE endless stream of bicyclists that once giddily flashed by on our avenues has gone to join the brimming river which leads to the ocean of forgotten things. In place of the high-pitched, tinkling cycle-bell we now hear the deep-sounding clang of the automobile-gong. The bicycle maker, through some unaccountable whim of Dame Fashion, has been compelled to convert his cycle factory into an automobile plant. Instead of a two-wheeled machine, limited in its scope by the physical endurance of its driver, he has turned his attention to the making of a four-wheeled machine dependent for its power not upon its occupant but upon some mechanical agency. It is the type of vehicle that has thus supplanted the bicycle which it is our purpose to study in the present article.

The vehicle which most nearly approaches the bicycle in form is the motocycle. Driven partly by human, partly by mechanical power, it is the connecting link between the bicycle and the automobile. And, in truth, we find that in France many a bicycle rider has cast aside his wheel and adopted the motor-driven bicycle or tricycle. Popular as the motocycle is abroad, it is rarely indeed that we find it used in the United States. It may be that in time its cheapness, in comparison with the four-wheeled carriage, will find for it a ready sale, and will induce Americans to manufacture it more extensively than at present. But, now in the infancy of automobilism, the light, two-seated carriage which the Frenchman terms a "voiturette," is the type of motor-vehicle which, in America at least, has begun to supersede the bicycle.

Voiturettes may be divided into three general classes: petroleum, steam, and electric carriages. True it is that there are other mechanical means of propulsion, that vehicles have been driven by compressed air, acetylene gas, carbon dioxid gas, and the like; but the carriage in general use the world over derives its power from one of the three sources mentioned.

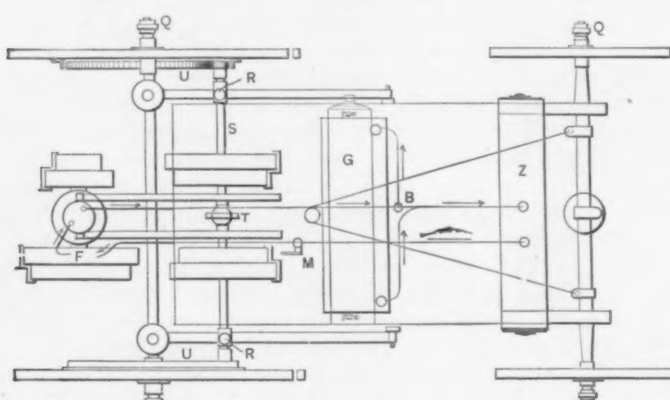
The petroleum voiturette is primarily an European invention; and to Europe we must go to study its development. The rise of the petroleum-carriage began with the advent of the Daimler



Daimler Carriage in Side Elevation

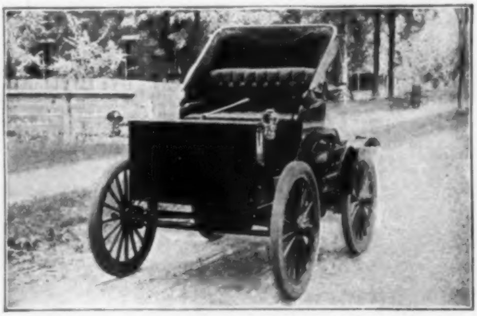
motor; for, before Daimler's time, there was no engine in existence compact and light enough for carriage use. Although a German invention, the Daimler motor was first generally introduced in France, for the very good reason that it found no encouragement in the land of its birth. The Daimler carriage may therefore be regarded as the first successful modern voiturette. To this very day it is one of the most widely used light carriages in the world. In its general features it has not been essentially changed from the time of its first appearance.

In the Daimler voiturette the power is transmitted by means of belts running over tightening pulleys, by the use of which any



of the speeds due to the different sizes of the pulleys can be used. Cooling is effected by directing the heated water into the annular channel of a wheel similar to the water-channel used in friction-brake dynamometers. The warm water is whirled at the speed of the engine flywheel and is taken back by a tubular offtake of the type used in milk separators. The whirling and the evaporation together effect a considerable reduction of the temperature. A carbureter of a novel form is used, in which no air regulation valve is required.

When the Daimler autocar proved a success, other manufacturers immediately sprang up. Not many years passed before the petrol-automobiles of De Dion, Peugeot, Benz, Mors, Bollée, Renault, Turgan-Foy, Underberg, Bouquet-Garcin-Schrive, Dietrich, Delahaye, and Hurtu, sprang into prominence. It



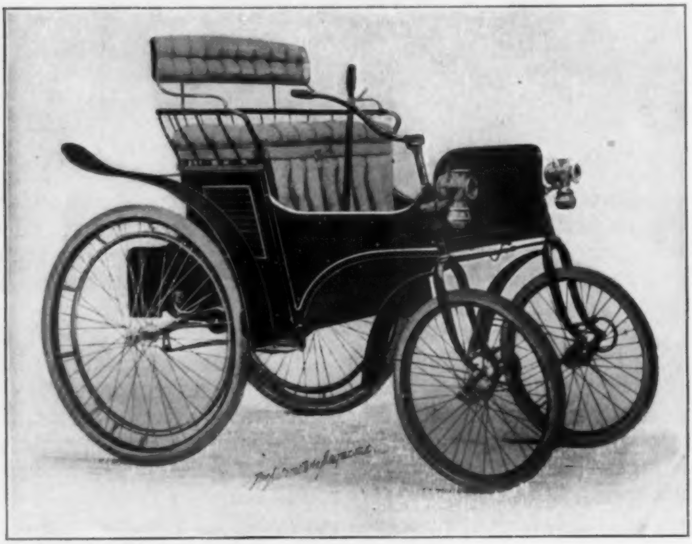
American Gasoline Buggy

would evidently be impossible, with the limited space at our disposal to describe all the voiturettes made by these firms; and we shall, therefore, confine ourselves to a description of a typical carriage in which are included the general features of the vehicles now in use abroad.

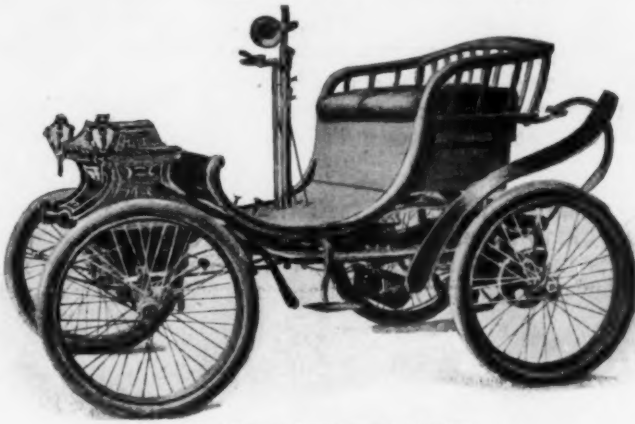
The petroleum voiturette consists usually of a light but strong tubular steel frame, upon which the carriage-body, motor and driving mechanism are mounted. The carriage-body is essentially similar to that of a horse-drawn vehicle, although it is designed to contain various apparatus not found in ordinary carriages. The motor is driven either by petroleum or by petroleum-spirit; and its cylinders are cooled either by flanges, whereby a great heat-radiating surface is obtained, or by means of a more complicated water-jacket, in which a constant circulation of water is maintained. The vaporized, carbureted petroleum is

admitted to the cylinder by special valves, and is exploded by means of an electric spark, or a burner. The successive explosions reciprocate the pistons within the cylinders, causing them to turn a driving shaft connected with the driving-wheels of the carriage by gearing, by chain and sprocket, or by belt and pulley. A speed changing gear is provided by which the velocity of the motor shaft is reduced to the speed required of the driving wheels. Many petroleum voiturettes differ from one another merely in the form of speed-changing gear used; indeed, the hunt for a good, variable speed gear has not yet ended. Within reach of the driver's hand are a crank-wheel to start the motor, handles to control the ignition and admission of gas; levers to command the speed-changing gear and the brakes; and a handle-bar or wheel for steering. These in brief are the characteristic features of most voiturettes.

From a mechanical point of view the petroleum voiturette leaves much to be desired. Gas and oil engines, if the truth must be told, are still but crude contrivances; inventive ingenuity has not been lavished upon them as upon the steam-engine. There is much room for improvement in the means for feeding a given quantity of gasoline into a given quantity of air; and



Oakman Gasoline Buggy



Dalifol and Thomas' "Jack"

for having little more than enough of the explosive mixture in reserve than is necessary to charge the cylinder at the next inspiration. The reduction of the vibration is another problem that has been but imperfectly solved. Although two opposed cylinders with a flywheel of moderate weight have worked fairly well, it will perhaps be found that three or four cylinders set in any convenient manner will better answer the purpose of lessening the vibration.

Lightness—a prime requisite in a voiturette—prevents the adoption of any heavy mechanism for cooling the engine. If water be used, as in many French carriages, water-cooling tubes provided with fins for radiation should be employed, the whole contrivance being arranged in coils. As a general rule motors of small horse-power usually employed for voiturettes are provided with no other cooling means than thin flanges for increasing the heat-radiating surface of the cylinder.

One of the troublesome features of the petroleum voiturette is the necessity for starting the engine by hand. Some automatic device, simple and practicable, should be devised, which would dispense with the necessity of twisting one's arm out of its socket in frantic attempts to start up an engine.

A good, practicable reversible petroleum motor would be a boon to the *chauffeur*. It would do much to simplify the mechanism of the voiturette; for it would dispense with complicated reversing gears.

To be sure we have not enumerated all the evils of the petroleum voiturette; but those which have been mentioned are the

most important and the most difficult of remedy. It remains to be seen whether American ingenuity and American inventive genius can solve the problems which have baffled French and German engineers, whether foreign designers cannot be excelled in their own special department of thought and labor.

II.

The steam voiturette with the introduction of the "Locomobile" has of late assumed a rank even higher than its most ardent champions hoped. Although steam was the earliest source of motive power in the first mechanical road carriages ever devised,

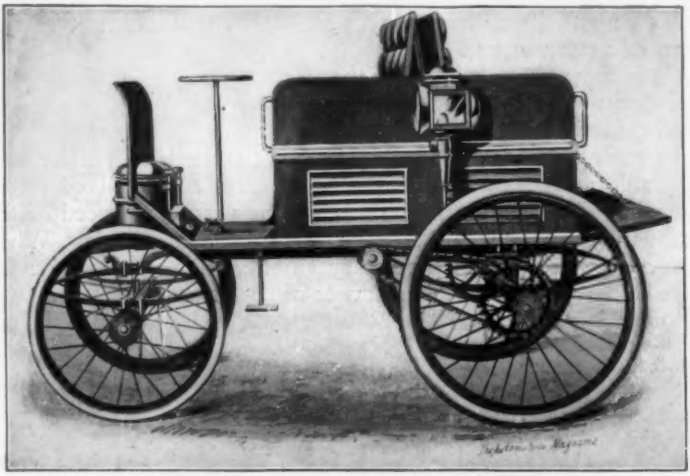
Locomobile Road Wagon

no truly successful steam vehicle appeared until very recent years. The development of the steam voiturette, like that of the petroleum carriage, is connected with the development of a suitable motor; and it was not until Serpollet invented the boiler which bears his name that the prospects of steam automobilism assumed their present rosy hue.

Serpollet's generator is a capillary water-tube boiler, the tubes of which are made in crescent form and cast in an iron casing. It is an instantaneous generator into which the feed-water is forced as steam is required. The tubes must be capable of withstanding heat whether they contain water or not. The boiler as used in the Serpollet voiturette carries a pressure of 300

pounds. The engine employed comprises a pair of cylinders with the crank shaft connected with the driving-wheel by chain and sprocket. The exhaust steam passes into the chamber above the fire-space, thence into the chimney in a superheated condition, and out beneath the carriage. Sufficient fuel is carried for a trip of forty miles; but the water-tank during that distance must be replenished from time to time.

From the pioneer steam voiturette of Serpollet to the modern, light and graceful automobile is a far cry. But the vehicles which followed the appearance of Serpollet's carriage early in the nineties, are of such trifling importance, compared with the two



French Steam Carriage

carriages mentioned, that their omission may well be pardoned in a brief review of the voiturette.

The distinguishing feature of the "Locomobile," as in the Serpollet carriage, is the steam-generator. The boiler used is composed of a cylindrical, wire-wound, sheet-copper body, at each end of which is a steel plate pierced with 300 holes to receive as many copper tubes providing flues for the hot gases coming from the hydrocarbon burner beneath the boiler. A second, interior, cylindrical casing receives the hydrocarbon, already vaporized by its passage through a feed-tube extending to the boiler and connecting with the burners. The second cylindrical casing contains 114 short copper tubes forming as many air flues,

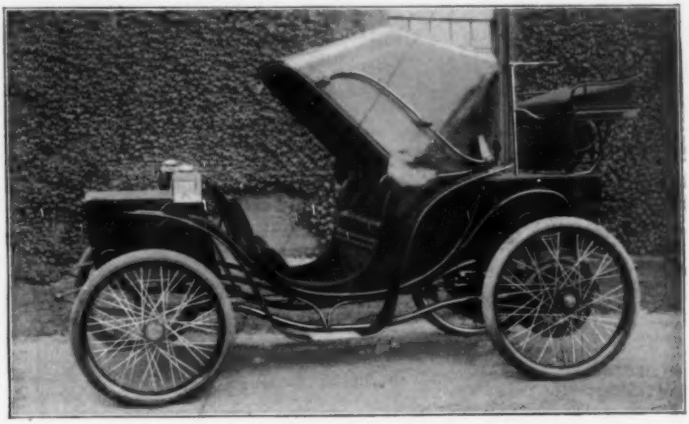
about which are located 20 capillary orifices through which the flames of the burning oil escape to heat the vertical tubes of the boiler.

The motor used is a miniature double-cylinder marine engine, the reciprocating motion of the pistons being converted into rotary motion by the usual connecting-rods and cranks. Sprocket and chain are used to transmit this motion to the driving-wheels.

From the engineer's standpoint the steam voiturette of the most recent type is perhaps a more satisfactory vehicle than the petroleum carriage. The steam-engine has certain indisputable advantages over other motors. It can be stopped and started at any instant and made to give any power from a few foot-pounds up to its full capacity. It has more latitude than any form of motor in use.

It is somewhat astonishing that a rotary engine of the turbine type has not yet been applied to the voiturette. The power developed within an incredibly small amount of space, and the great saving in weight would render the turbine particularly adaptable to the automobile. The problem to be solved is the provision of a gear which will reduce the very high speed of the steam turbine down to the speed of the driving wheels. When such a gear is devised, the rotary engine will prove itself a far more economical and efficient source of power than the high-speed reciprocating engine.

Gallet Hasse's Gazelle



Electric Vehicle Co.'s Victoria

III.

Wellnigh countless is the number of electric voiturettes. Their name is legion. It would be a task of no mean proportions, even with unlimited space at one's disposal, to describe all the various forms of the light electromobile; for which reason following the course already pursued we shall confine ourselves to a description of the general type.

The electric voiturette includes in its driving mechanism a storage battery, one or more motors, and a compound switch or controller. Within reach of the driver's hand are a controlling handle, a reversing handle, by which the direction of the vehicle can be reversed, a brake-lever, various switches, and instruments of electrical measurement. The accumulators are capable of yielding a certain amount of power—an amount which varies with the manner with which it is applied.

In certain respects the electric voiturette is the simplest form of mechanical carriage at present in use; but its advantage of simplicity is offset by defects which are very generally known and which have been very exhaustively discussed. The *bête noire* of the electromobile is the storage battery. Its weight is out of all proportion to the energy which it yields. Its limited capacity restricts the carriage in its sphere of action. It often short-circuits; its plates buckle and disintegrate; its cells deteriorate. But with all its deficiencies, the electric voiturette is the speediest

automobile built, the carriage most popular in this country, the vehicle generally chosen for racing purposes.

IV.

What will be the voiturette of the future? Will petroleum, steam, or electricity triumph? It is doubtful whether power alone will determine the type of the coming light road-carriage. The vehicle which will be most widely used, will undoubtedly be that which is the simplest, that which can be most readily operated by men of little mechanical sympathy. Little or no skill must be necessary; otherwise the automobile will find as scant favor with "the man in the street" as a complicated airship.

The subject of speed will receive more attention as the voiturette will be more generally used. Beyond a doubt many of our manufacturers are at present sacrificing too much to speed. Are great speeds at all necessary in ordinary voiturettes? It is manifestly useless to build carriages for very high speeds; for they will not be permitted to run beyond a certain maximum point. Even if the law do not restrict the swift automobile, it is doubtful if the more sober-minded *chauffeurs* will buy carriages with powerful engines, the full energy of which will rarely be used. Lightness, as well as simplicity, is one of the prime requisites of a voiturette; and lightness can be obtained only by motors and gears of small weight.

Barré Voiturette

The Practical Automobile of the Future

By E. E. Schwarzkopf

TO judge properly the state of affairs in automobilism, we have to elevate ourselves above the general opinion of the automobilist. Ignorant of what is going on in the factories and laboratories he is naturally a partisan of the automobile *en vogue,* moreover he becomes a fanatic defender of the machine he has bought, the one which causes him no end of trouble.

A review of the development of the automobile shows us the locomotive descending from its rails to the ordinary highways giving thereby the first impulse to the automobile, but the heavy weight makes the road locomotive impossible.

All efforts were directed to diminish the weight of the boiler, the engine and all other mechanical parts. The outcome of these attempts were the Serpollet steam motor with instantaneous vaporization, and the light locomobile invented by the Stanley Brothers.

In the meantime, new horizons opened up to mechanical propulsion and traction in consequence of the application of electric accumulators.

The simplification of electric control and the possibility of placing its mechanism upon any carriage arrangement whatever caused the excessive weight of accumulators required by the use of electric motors to be overlooked, and placed electric force in the very front rank of such forces as had as yet been employed for actuating vehicles mechanically.

The cherished dream of a motor driven by a force that should be supplied without any visible source than that produced in the form of carbureted air (gas, gasoline and alcohol) was realized. But that motor, apparently so simple, which was to give so great an impetus to automobilism, seems at present to have become a pitfall. In fact, far from accommodating itself, like the electric motor, to the most advantageous arrangement of the structure of vehicles, it occupied the latter entirely, with the result that, by taking the place of the passenger, it relegated him to the front of the carriage. This inconvenience would

have been of but secondary importance had it not been accompanied with that of requiring a rigid general arrangement, causing the disappearance of the very practical steering fore-carriage, and the substitution therefor of pivoted wheels, which, on account of their turning about in steering, are very dangerous.

In whatever state of progress automobilism may be, and however perfect the automobiles upon the road to-day may seem to the inexperienced, disinterested professionals know that this industry has not as yet finished its travail. Far from having gotten beyond the period of transformation, in order to enter that of improvement, automobilism is giving rise to experiments of which the object is to create new combinations that will have the result of allowing the carriage to retain its true character,

Vollmer's Commercial Delivery Wagon

and of abandoning to lovers of sport those vehicles of unnamable forms—those species of hearses, in which it is difficult for the vehicle to afford even one compartment amid the mechanical parts, which make a workshop out of what should be a carriage.

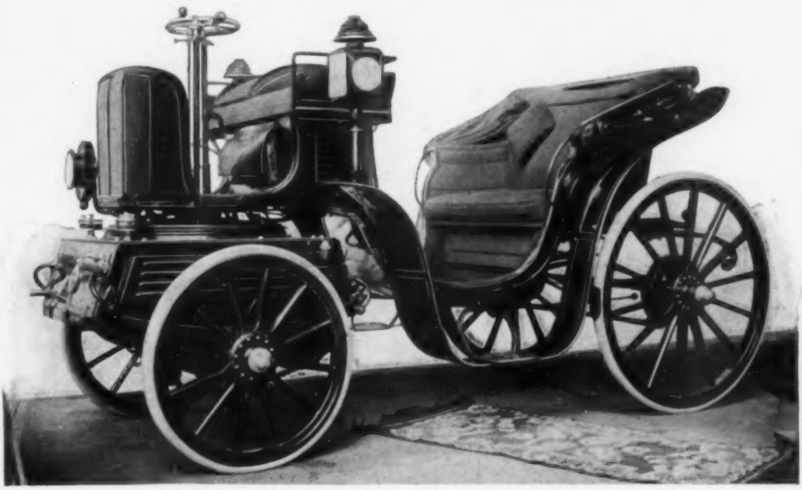
We do not care to attach any importance to those improvements in details that abound, since what exists, being defective at the foundation, is not perfectible.

What the world of automobilists regards with admiration at present is certainly not the mechanical carriage of the future, that which our children will improve, and that which will cease to be the preference of lovers of sport.

In order that the automobile may enter the practical period, front traction must be substituted for rear propulsion, and the

vehicle must be disburdened of wheels turning around a pivot. These two improvements will go hand in hand with the suppression of the four-cycle gas motor with a flywheel. This latter improvement will involve all the others. The association of the said motor and all the accessories requires too much space to allow them to be placed advantageously in front.

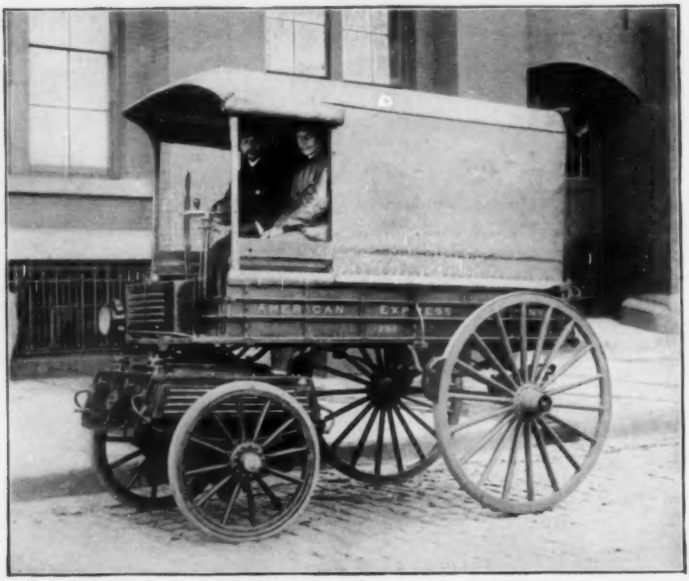
Taking such requirements into consideration many French and German engineers, like Vollmer, Blot, Pretot, Darracq, Doré, de Riancey, Krieger and Ponsard Lucie Marzia, have been led to invent an automobile actuated by its fore-carriage.



Vollmer Victoria

But most of these experiments, of which several indeed seem as if they were to be put to practical use, encountered difficulties connected with steering and controlling. Such difficulties, however, the German engineer, Vollmer, in connection with a hydrocarbon motor, and the French engineer Blot, in connection with a rotary steam engine with conjugate helices, have triumphantly overcome.

We have said that the mounting of steam and gasoline motors upon fore-carriages, in view of the complication involved, not only by their installation, but also and more especially by their control, presents great difficulties; while electric motors, on the



Vollmer Forecarriage, hitched under a Delivery Wagon of the American Express Co.

contrary, naturally find their place upon this part of a vehicle, since they necessitate no rigid controlling parts. We find that a number of experiments are being made in this direction, and observe numerous front-hauled electric automobiles already running in the streets, while the number of front-hauled vehicles actuated by steam or gas motors is very limited. And yet the application of gas and steam motors to automobiles is rendered peculiarly easy by the cheapness at which automobilism obtains its force.

But it is toward the lightness of the parts of the engine, and toward their grouping that all the efforts of inventors seem as yet to be directed, and the question of economy is relegated by them to the background.

Engineer Vollmer and also Engineer Blot have taken such observations into consideration, and the following is a sketch of their conceptions.

In both devices the entire mechanism is placed upon the forecarriage. This latter is a tractor, a steerer and a controller, in

other words, it serves at the same time to haul the vehicle, to steer it and to control it, as required by the driver.

The fore-carriage embraces within itself the whole mechanism, the controlling apparatus which stands in front of the driver, so that when the fore-carriage is separated from its vehicle, it carries with it its entire controlling mechanism and may be immediately coupled to another vehicle.

It is in the combination of the motor with the vehicle that lies the problem of the automobile of the future. The combinations made up to the present have, as we have said already, had the effect of disforming the vehicle.

The fore-carriage system unites extreme simplicity with great strength, and has that essentially practical character that immediately attracts attention and permits, so to speak, to fill a public want.

The fore-carriage fully justifies the high estimation in which it is held, since it is the mechanical device par excellence that is to start automobilism upon a truly practical and economical path.

To answer the numerous inquiries we are daily receiving about the Vollmer Fore-carriage, we are authorized to state that the Automobile Fore-carriage Co., Astor Court Building, New York have not secured the Vollmer Patent, and that they are not authorized to make the Vollmer Fore, carriage —Ed.

Vollmer Vorspann

A False Alarm

By E. Y. H.

THE two brown mares, Lady Fay and Lady Gay, had their heads together as usual, and rubbed noses lovingly. They occupied adjoining stalls in the stable, but, in their case, distance would have had no power to make the heart grow fonder.

"What's the matter with Little Billy?" inquired Lady Gay anxiously, "he seems so forlorn, and hangs his head in such a dejected way that I believe he must have received bad news; perhaps he has lost some friend or relative in the South African war—a cavalry charger, mayhap.

Lady Fay turned her head lazily in Little Billy's direction, and gazed at him calmly and deliberately with her soft, large and sleepy eyes seemingly only half open. In harness Lady Fay was as frisky and lively as her master could desire, but out of harness she made it a point to cultivate a languid and blasé air, to the secret amusement of Lady Gay, whose manner was the same at all times and in all places.

It would have been evident to the most careless observer that poor Little Billy felt indeed forlorn. He turned his back on his fellows, left his oats untouched, and neighed and whinnied in a manner that might have moved a heart of marble.

"Why, Little Billy, dear Little Billy," cried Lady Fay, roused from her apathy and neighing out of genuine sympathy, "what has happened; are you in any trouble?"

"Yes; something dreadful *has* happened," answered the old horse with a mournful shake of the head. He was silent a moment, and then with a jerk, as if it were necessary to force the hated word out, he added: "Automobiles."

"Automobiles!" repeated Lady Fay. "Automobiles!" echoed Lady Gay. "We have never even heard of them," cried both mares in one breath.

"Neither had I until a few days ago," said Little Billy, "Master John the other day was driving me tandem with Fleetfoot down that long country road between Bryantwood and Old Port Leicester. Suddenly an automobile went whirling and whizzing by, and I hope I may never live to see another. Well, I am an old horse now. I have had my day; I have had my day," he continued, half to himself, "and man is welcome to

improve on me with his modern appliances and new-fangled inventions, but I must say," raising his voice a little, " it's desperately hard on young things like you, with life before you. I don't see what in the world is going to become of you."

" Don't worry about us, Little Billy," answered Lady Gay, " we shall manage to take care of ourselves whatever happens. Lady Fay and I have plenty of good, old-fashioned horse sense. But we have not the ghost of an idea what awful fate is hanging over our heads, and what kind of a monster an automobile may be."

Fleetfoot, who had been Little Billy's companion in the eventful tandem drive, looked mysterious.

" For my part I call it more of a freak than a monster. Shades of Pegasus! it did not frighten me a bit, and I wonder that a grave and dignified horse like you, Little Billy, could show the white feather, and rear and plunge like an untamed colt at such a trifle."

Little Billy looked rather shame-faced, and did not attempt to defend himself.

Lady Gay, however, was the personification of anger; her nostrils quivered and her eyes blazed.

Little Billy was a great favorite of hers, and she could not bear to hear him ridiculed—by Fleetfoot, least of all.

" For shame," she exclaimed passionately, " how dare you speak so! Little Billy is worth a thousand of you, and yet you have the face to sneer at him before the whole stable. Wait until you are old as he is, then you will find that 'trifles' have power to alarm you, and that the want of thought and sympathy in others will make you realize your own old age and helplessness."

After this storm of invective, under the pretext of munching a few oats to satisfy hunger, but in reality because he felt the current of public opinion to be running strongly against him, Fleetfoot had the grace to hide his head in the manger and take no further part in the discussion.

" Tell us, Little Billy, what *are* automobiles?"

By this time the curiosity of every horse in the stable was roused, and all waited impatiently for an answer to Lady Gay's question.

" I could not have given you much information a week ago," he responded, " but now that I have seen an automobile in action, besides having overheard a conversation between the coachman and the stable boy, concerning its mechanism, advantages, and shortcomings, I may be able to describe it to you.

"Two or three days ago, after that tandem drive, Joe and Timothy drove me down to Bryantwood.

"We went along in silence for some time, then Joe spoke, 'Say, Tim, I saw quite a big lot of those automobiles last time I was up to the city for Mr. Hallowell. Master, says he, "keep a sharp lookout for them automobiles, and learn all the particulars yer can about them." Seems he thinks o' gettin' rid of several of the older horses, Little Billy as we're a-driving now and the likes of him, and investing some capital in these new inventions. Well, they *are* just the queerest! Have a sawed-off, not-quite-all-there kind of a look. Horseless carriages, motor cars, or electric wehicles is what them city chaps calls them. Some is propelled by what is known as gasoline—same stuff, yer know, as the women folks use to rub fruit stains and all that kind o' thing out of their dresses. Land's sakes, Tim, yer just should hear the fuss and commotion them gasoline ones make. I'll be jiggered they ought-to-go after blowing their own trumpet in such a brazen way. Ha! Ha!'

"Here Joe laughed hugely at his own joke, and I thought he would never know when to stop.

"You may be sure I was feeling very badly; it was not pleasant news that had been sprung on me. I have grown old in my master's service, and after having served him faithfully all these years, I am now to be sold—to some rascal of a horse-dealer, I suppose, so that there may be cash in hand to buy, and room in the stable to keep one of those dreadful automobiles.

"Tim, however, did not appear to appreciate the coachman's wit. Indeed, he was unusually silent. You know, as a rule, he is rather a talkative fellow. So I was somewhat surprised at his silence."

"'Well, I call it a crying shame,' says Tim, 'if master sells Little Billy. And him so quiet and good, too! Why, he is the best horse we have by a long shot, and has never been known even to kick. Don't believe any automobile, not even a fierce and screeching one, could make up for a-losing him. Shan't say anything more about it, though, being sort o' worked up on it, and when a feller feels that way—well, as they taught me at school, silence is golden.'

"Here the talk drifted into other channels and was not particularly interesting to me.

"The previous remarks that had been made on automobiles and my probable future gave me plenty of food for thought, and threw me into a most uncomfortable frame of mind.

"Well, friends," here Little Billy paused, threw back his head

proudly, and let his gaze wander over the stable. Every horse was listening intently, and Little Billy was assured of the fact that he had sympathetic and respectful hearers.

Little Billy continued, " I am afraid my fate, at least, is sealed, and there is no telling when yours may be. Sooner or later, I suppose, for these automobiles seem to have come to stay. From all accounts they are a great economy, saving their owner's time, money, and trouble. It is a hard thing to own up, but I am played-out now. Automobiles are new and they will sweep clean as like new brooms."

The effect of Little Billy's words on the other horses had been most profound. He had spoken—now passionately and angrily—now softly and pathetically, and he had never for an instant lost their undivided attention.

Lady Fay was not an emotional creature, but it was evident that Little Billy's words had touched her, even as they had Lady Gay.

The mournful way Lady Fay shook her pretty head, and her pitiful little whinnies were very expressive of her deep sorrow and sympathy for Little Billy; and they drew an admiring glance from Fleetfoot, who by this time had somewhat recovered from the effect of Lady Gay's sharp rebuke.

Fleetfoot stood in great awe of Lady Gay. She was certainly very much of an obstacle in his path and kept so close a watch over her friend, that he had to resort to all kinds of curious expedients to carry on his flirtation with Lady Fay.

But he was a plucky horse, full of dash and spirit, and we may be very sure he was just the one to win a lady's favor, and that in spite of Lady Gay's watchful care, he finally succeeded in his wooing of the pretty chestnut mare.

The subject of automobiles, being an extremely disagreeable one, was dropped from general conversation by common consent. It was only spoken of in whispers, and very seldom. There was a skeleton, a gruesome and horrible one, in the stable now to cast a black shadow over everything and everybody, and make life scarcely worth living to many of its inmates—and that dreaded skeleton was nothing but an automobile!

And yet they talk about " horse sense!" Why, " there ain't no such thing as horse sense," to quote that worthy authority, David Harum.

Little Billy had described himself as " played out." The truth of his description became more and more apparent as the days went by. He took little notice of his old friends, and seemed to find his greatest happiness in being thoroughly miser-

able. It was not by behaviour such as this that he had become the reigning favorite with every horse, mare, and colt of his acquaintance.

Little Billy, who had once been the life of the place, now so cheerless and sad!

But his friends understood; even Fleetfoot realized what had so completely changed Little Billy, and treated him gently and considerately in consequence.

But it so happened that the poor old horse was making himself unhappy over an imaginary grief after all.

An automobile, gaily cushioned and brightly enamelled, soon made its appearance in the stable, but Little Billy and his old friends lost no share of their master's affection and gratitude.

They were not sold, but put out to pasture in a pleasant orchard, and in winter time the old coachman gave them the care and consideration due to veterans grown gray in service.

Wonderful to relate, Little Billy learned, in course of time, to regard an automobile not only with composure, but with downright gratitude in his equine heart.

The Jingle of a Joyful Jehu

Frank X. Reilly, Jr.

" Behind the fretful beasts I've sat for years
A-jigglin' an' a-jugglin' of the reins,
A-whiskin', through the avenoo, my peers
Or haulin' timber through the country lanes.

" I've drove most everything from dray to hack;
From a thousand ears I've flicked as many flies;
Through ups an' downs an' downs an' ups—an' back—
I've broomed an' curried hosses—to the eyes.

" But I'm not sorry after all, at bottom;
I knew it was a-comin' at the start,
When the master he talked catalogs, an' got 'em,
An' now I run a red-wheel hossless cart!"

The Automobile in Colonial Development

By Sylvester Baxter

THERE can be no question that the automobile will play a most important part in the development of the new colonial possessions of the United States. What those countries need for the adequate exploitation of their immensely rich resources is proper transportation facilities. New railway lines, of course, will supply these to a very great extent. But all of them are greatly in want of proper systems of highways and one of the things to which attention on the part of the new governing powers must be given in the near future is the supply of this want.

It is not meant by the foregoing that there are no proper highways on the various islands that have lately passed into our control. There are good highways to be found in Cuba, in Puerto Rico, and even in the Philippines, but what is wanted in each and all is a thoroughly planned and developed system. The fact that some excellent roads exist there already implies that many of the kind can exist there equally well. Cuba is often spoken of as a country absolutely without roads. This is doubtless true in regard to certain districts. But in the western part of the island, in the neighborhood of Havana, there are good roads in considerable number, and a most interesting account of an automobile excursion from Havana for a considerable distance into the country lately appeared in the newspapers. General Wood made a splendid beginning with a system of perfect macadamized highways for Santiago Province while he was Governor there, and also gave the City of Santiago a superb asphalt pavement for its principal streets. General Wood is a man who appreciates the meaning of good roads for civilization, for good order and for prosperity. And now that he is Governor-General of Cuba he will naturally make it one of his main objects to cover the entire island with a network of good roads. Our very sensitive friends, the Cubans, may object to seeing their island considered under the caption of this article. The writer, however, is actuated by the sincerest regard for their welfare, and a discussion of the subject would hardly be complete without a consideration of the conditions of the problem in Cuba, whether or no that island is permanently to be a colony, dependency or

integral part of the American Union. The fact remains that the Americans are now in control there and are responsible for the proper development of the island in the ways of peace and prosperity. And its endowment with a first-class highway system and the proper utilization thereof by the best possible means of modern transportation must be one of the main instrumentalities to that end. Until this work has been thoroughly carried out our mission in Cuba cannot properly be ended.

The torrential rains of the tropics are often pointed to as a great obstacle to the creation of satisfactory roads in such countries, their forcè making the maintenance of the roads impracticable without an enormous expense. The actual facts, however, do not support this theory. A good road will naturally go to destruction sooner or later if due care is not given to it. But in various parts of Europe many good roads built by the Romans are in regular use to-day. The tropics do not have the destructive action of frost to contend with, and the harmful influence of heavy rains can be counteracted by well considered engineering in the first place, proper construction in the second place, and careful maintenance in the third place. The Dutch have created in the Island of Java a system of superb roads from end to end. With the luxuriant vegetation they make the island like one great park throughout, so that traveling there is a rare delight. The British have done a similar work in India and in other colonies of theirs. It is evident that we can accomplish similar results in the Philippines. When we do, nothing will be a greater factor in the establishment of good order in the islands and in the achievement of an unprecedented prosperity there.

The Spaniards themselves have shown us what can be accomplished in that line in their former possessions. The trouble with them was not that they did not know how. They knew how most admirably. But they did not appreciate the importance of the work to the prosperity of their possessions. Or, if they did, the officials in charge did not care. If a fraction of the peculations which the governing officials committed, in oppressing in people with excessive taxation and then appropriating the greater portions of the revenues to themselves—if a fraction had been devoted to the establishment of good roads the increased prosperity would have made the people abundantly able to bear taxation.

Puerto Rico offers excellent examples of the best and the worst of highway conditions, side by side. Mr. William Dinwiddie, in his admirable book on the island,* tells us that the

* Puerto Rico: Its Conditions and Possibilities. By William Dinwiddie. Harper & Brothers, 1899.

finest road in the western hemisphere is to be found in the Island of Puerto Rico: "In fact it is a road equalling for surface and as a feat of engineering skill any in the world, with the exception of some of the marvellous roadways across the Swiss Alps. It was built by the Spanish Government at an approximate cost of four million dollars, for military purposes solely; and traverses the island from side to side diagonally across its very heart for 133 kilometres (over 80 miles)."

AMERICANS TOURING IN PORTO RICO

"This magnificent highway," says Mr. Dinwiddie, "was commenced in 1880, under General Sanz's military regime in Puerto Rico, and completed eight years afterwards by General Pulido Gomez.

"It is macadamized from end to end with finely broken calcareous rock, which cements itself into an almost solid floor. It has good bridges over the numerous fast-flowing streams, with

the exception of four small rivers just north of Ponce, and the gradients are as low as it is possible to make them without extreme tortuousness of the highway. Every few kilometres are found substantial single-storied houses, with red roofs, called 'camineros,' in which the road-tenders lived, whose duty it was to keep the road up to the high standard originally set by its promoters."

This road crosses the island through a wonderfully beautiful country—enchanting valleys, wild mountains, emerald vegetation, crystal streams, and a constant succession of tropical marvels. In passing over the mountains at various points it turns and twists in its course like a gigantic serpent trailing over the landscape.

Here is a sunrise scene on the road, described by Mr. Dinwiddie: "A thousand feet below us the thousand little valleys cut by the mountain streams and walled by steep ridges, covered to their very crest with the green of growing things, lay partially veiled in darkness or lightly masked by the white diaphanous clouds of vapor which seemed gently to caress each blade of green, as they slowly floated upward toward the now sunlit and tinted peaks above. It was a wondrous sight, such as could be found nowhere in our own country. Here was not the topography of the grandly sublime ranges we find in the Rockies, not the product of the awful powers of nature as displayed by the grim, barren, needle-pointed peaks and parched and barren valleys of our southwestern deserts. It was a landscape carved in surprising forms, with the elegance and symmetry of rounded hills and deep-set valleys, and everywhere covered with the magnificent foliage of a climate warmed by a torrid sun, and watered copiously, day after day, by a moisture-laden atmosphere."

The charm of this road must be something incomparable. It is evident that this glorious highway alone is sufficient to assure success for the automobile company which some of our enterprising countrymen have organized for Puerto Rico. The other extreme in the way of highways, however, is equally in evidence on the island, and unfortunately it affects a greater number of the inhabitants. It is an abrupt transition from the perfection of road-going presented by the great military highway to the ordinary roads that alternately have the character of a slough and of the bed of a dry mountain stream. And still worse are the trails that form the major portion of the highways on the island, practicable only for saddle and pack animals.

A typical road of the bad variety is that represented by the greater part of the way from Ponce to Adjuntas, through one of

the finest coffee regions in Puerto Rico. The first 12 of the 30 kilometres are over a good military highway, but the rest of the distance is most painfully traveled. The beautiful macadamized road ends abruptly at the turning of a rocky cliff, and the rest of the way there is quagmire after quagmire. "All that is lacking to convert the remainder of this road to Adjuntas into a fine highway," says Mr. Dunwiddie, "is the macadamizing of its bed, for the survey and earth-cutting were completed many years ago. The natives will assure you that it is a 'camino real,' but that it is 'mucho malo' in rainy weather. Its frightful condition is much augmented in the coffee-packing season by the heavy ox-carts which are laboriously hauled through the axle-deep mud by many yokes of oxen. There are almost ten miles of up-hill work from the ocean side before the high, sharp crest of the mountain-range, 1,700 feet above sea-level, which overlooks the Valley of Adjuntas, is reached. There are many exquisite windings in this miry road; here it overlooks a gorge 600 feet below, from which rises the hollow roaring of cataracts hidden away from sight by the rank and overarching vegetation; there it abruptly swings around into a deep re-entrant, across whose horseshoe form the meandering road may be seen half a mile away, and in whose deepest curve a beautiful cascade noisily dashes from rock to rock, embowered in the green of ferns and vines and lanias.

"From the great crest at the top of the range, the ocean, a dozen miles away, seems to rise up on its outer edge like the curving of a huge saucer, and the few vessels far out on its waters are but tiny specks through the glasses. Toward Adjuntas, range after range of mountains is seen to the northward, and it is seldom that so rough a landscape is found in such a small area. Not a foot of the country, so far as the eye can reach in this direction, seems to be level, and yet this valley and the one of Utuado beyond are among the foremost coffee regions of the island. The road down the mountain to Adjuntas is formidable. Out on the ragged edge, overhanging the deep ravines, is a pathway good and firm; inside, for 15 feet to the edge of the heavy hanging wall of rock, it is knee-deep and even breast-high with mud, so tenacious, so well kneaded by floundering horses and cattle, that every withdrawn hoof gives off a report like drawing a cork from a bottle."

It is evident that the finishing of this road, so well begun, would be an enormous boon to the people of this district. To carry the coffee crop to market over such a highway must be tremendously expensive. But if the road were carried out as was

intended, coffee-raising, even under the present depression existing in the island owing to unsettled economic conditions, ought to be immensely encouraged by the reduction in cost of transportation.

Under an enlightened development such roads will be constructed to every inhabited part of the island. The resources which will soon be available for systematic development should be applied in generous measure to this end. While railways will probably be built to a considerable extent and will be of much use, still railways are not so important as a general system of good roads. In a country so rough in surface and so mountainous the building of railways on an extensive scale would be peculiarly difficult and costly. But no part of the island lies at a great distance from the sea; only a few hours at the most, if communication were over a good road. If such roads were constructed and made in the same admirable manner as the great military highway and the various sections of projected roads that have been built here and there they would furnish ideal

Colonial Stage

transportation lines in connection with automobile facilities. The cities and towns of the interior would be connected with the ports by motor-omnibus lines, offering a form of travel immensely more agreeable than by railway cars and practically as expeditious. Individual automobiles would come into universal use, and it would be one of the keenest enjoyments to explore the enchanting scenery of Puerto Rico by such means. And with the aid of automobile traction the movement of the rich products of the island to market would be cheap and expeditious. The life of the whole island would thus be quickened, materially, mentally and morally. Industry would be encouraged, prosperity would be assured, the earning-capacity of the common people would increase, and with it their purchasing-power, new wants would be created and commerce would expand, particularly with the adopted-mother country. Exceptionally dense though the present population of Puerto Rico is, under the new conditions effected through universal good roads and the automobile that it might increase very much above the present total and at the same time be blessed with a remarkable degree of prosperity, raising the entire community to higher levels.

Puerto Rico is cited more in detail as furnishing concrete illustrations of the best and the worst conditions of highway development side by side. But the same considerations will hold equally good in the cases of Cuba, Hawaii, and the Philippines, in all of which the automobile will certainly become a most potent instrumentality for regeneration.

CONTINENTAL RESTRICTIONS

In Belgium all automobile vehicles must carry both in front and behind, a number large enough to be seen at a distance, and after sunset each number must be lighted by a lamp. All automobiles and bicycles must be provided with a brake. All self propelled carriages must also bear the regulation number of the city and also the owner's name and address. Rubber-tired carriages must carry bells, and the maximum speed allowed is 18.64 miles an hour in the open country, and 7.46 miles in town.

Doctor's Buggy

A Gasoline Carriage for Physicians

AMONG the small gasoline carriages that attracted the attention of visitors at the recent Salon du Cycle, may be mentioned the "Æsculapius," a vehicle, as its name implies, particularly designed for the use of physicians, but well adapted also to the needs of those who are looking for a small, strong and compact automobile capable of running with regularity.

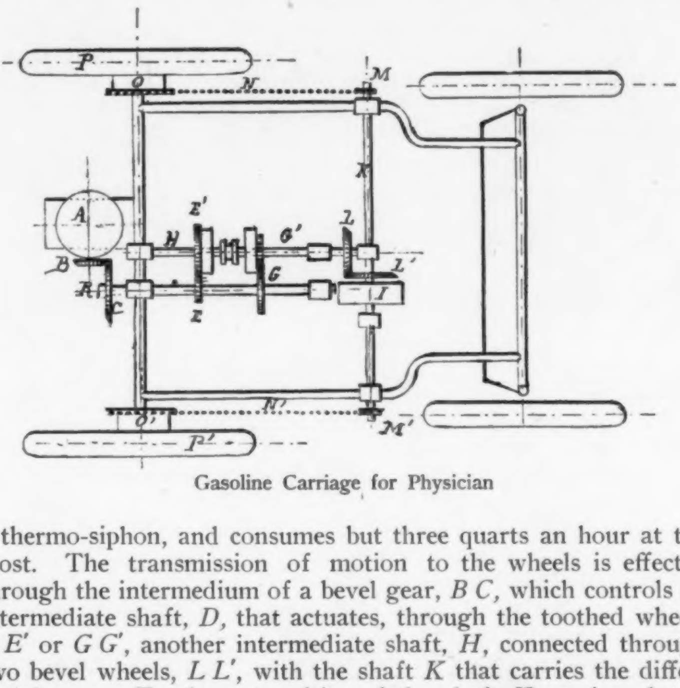
This carriage, which is constructed with great care, and is well finished in all its details, is actuated by a De Dion-Bonton motor, of which the explosion chamber is cooled by a circulation of water.

Its weight, when empty, does not exceed 440 pounds, and its dimensions are 6.5 x 4.4 feet. Mounted upon wheels pro-

vided with tangent spokes and thick pneumatic tires, the "Æsculapius," as may be seen from Fig. 1, offers all the comfort that could be desired.

The steering is done by means of a divided axle controlled by a lever with a handle. The frame is constructed entirely of steel tubes, which give it lightness as well as strength, and rests upon springs that afford the motor and the speed changing gear all the advantages of a spring suspension.

The motor (*A*, Fig. 2) is placed in the rear. The ordinary explosion chamber has been slightly modified so as to permit of a circulation of water derived from a 3¾-gallon tank placed in the box of the carriage. The circulation is brought about by



Gasoline Carriage for Physician

a thermo-siphon, and consumes but three quarts an hour at the most. The transmission of motion to the wheels is effected through the intermedium of a bevel gear, *B C*, which controls an intermediate shaft, *D*, that actuates, through the toothed wheels *E E'* or *G G'*, another intermediate shaft, *H*, connected through two bevel wheels, *L L'*, with the shaft *K* that carries the differential gear. To the extremities of the shaft *K* are keyed two sprockets, *M M'*, connected by chains, *N N'*, with two toothed wheels, *O O'*, which are fixed respectively to the driving wheels, *P P'*.

The groups of toothed wheels *E E'* and *G G'* constitute two changes of speed. Of these wheels, which are always in engage-

ment, E' and G' are loose upon the shaft that carries them, but are capable, when need be, of being rendered fast upon it by means of an elastic segment gearing of the kind employed upon American lathes.

A lever which controls a sleeve that slides upon the shaft *H* permits, at will, of throwing either one of the two speed gears into engagement without any noise.

The higher speeds are obtained by varying the ignition. Finally, one of the grips of the steering bar permits of arresting the ignition at will.

The starting is accomplished through a winch fixed at *R* to the extremity of the shaft *D*.

Three brakes, one of them placed upon the differential gear and controlled by a pedal, and the two others actuated by a lever and mounted upon collars secured to the driving wheels complete the carriage frame.

As for the speed of the vehicle, that, with two occupants, reaches from 15 to 17 miles an hour. All up-grades are ascended with the use of the low speed gear, the simplicity of the operation of which is such that it has never been known to fail.

AN INNOVATION IN HUNTING

A notable feature of the annual winter meeting of the Meadow Brook Hunt Club on Long Island was the presence of several automobiles. This was the first occasion in the American history of the sport on which the popular modern vehicle has taken its place in line with the road coach, the break and the whole range of sporting and road vehicles. A sight so novel naturally attracted much attention. Even the fashionable participants in the hunt, to whom automobiles are as familiar as four-in-hands, could not refrain from some expressions of surprise when they saw the noiseless vehicles speeding over the Long Island roads.

Mr. R. E. Flinsch came all the way from Rockaway in his automobile, and he held his own with the best of them. There was nothing worth seeing that he did not see. Mr. H. E. Cutting, who was accompanied by Mrs. Hermann Oelrichs, drove another automobile, and found it easy to keep his place in line. Before and behind him were persons in coaches, buggies and other varieties of horse drawn vehicles, many of whom were his friends, and all of whom watched him with keen interest as he skilfully steered his dainty carriage.

An Automobile Patrol Wagon

CHIEF OF POLICE HARRISON, of Akron, Ohio, has recently adopted an automobile patrol wagon. This wagon, judging by his own report, is as complete as any first-class wagon can be made. It is guided by a wheel in front, through a shaft and pinion onto a Parson's roller-bearing fifth wheel and lock on the steering shaft, so that it will run straight in the street without watching. It has three brakes, one band brake on the external diameter of the gears on rear wheels, controlled by a brass handle under the steering wheel, and it has an ordinary foot brake on the rubber tire, and with a connection and rheostat for converting the motors into a dynamo.

The propelling power consists of two six-horse, single reduction, multipolar series wound motors. The armatures have a special wind to use two or four brushes. The controller is of a peculiar design, with every contact consisting of a knife-switch pattern and a clear air brake at each contact. It has three speeds

forward, two back, and one charging combination, and a switch for cutting batteries out when wanting to leave wagon or make repairs.

The battery consists of forty cells of the Willard type of storage batteries, with a watt capacity of 13,440 at three-hour discharge rate, put in four trays of ten cells each, and being capable of three combinations for power, and a charging jack under seat, and also an automatic cut-out and rheostat on the wall for controlling the charging current, and volt and ammeter on wagon for rate of discharge.

It has an electric headlight, an electric light in the top of wagon, to light the interior, and an electric alarm gong for warning the public, and is equipped with side and end roller curtains for enclosing the entire wagon; has side brass handrails, and is upholstered with leather trimmings throughout.

Archibald wheels, 48 inches and 38 inches diameter; 2½-inch rubber tires; tread, 63 inches out to out; 2¼-inch Grant roller-bearing axles; four platform springs, front and rear, 2¼ inches wide; box is 4 feet wide and 10 feet long, 15 inches high under side seats; steps in rear, and controller lever on the left side of front seat.

One charge will carry the vehicle over 25 miles of ordinary roads. The wagon will make 20 miles an hour easily on paved streets. There are three different ways of applying the brakes. One is a roller brake on the wheels. A band brake working on the inside of the bull wheels, and an electric brake operated by throwing the controller back one point, making a dynamo of the motors generating a back current; this brake is only used when descending a steep grade. The wheels and fifth wheel are ball-bearing. Electric gong and head-light, and weighs 5,800 pounds. It has been run through mud six inches deep with as many people on it as could be seated.

Mechanical Propulsion and Traction

By Prof. G. Forestier

Fifth Paper

IN 1813, when, with the arrangements of the axles and hubs wholly of wood, the coefficient certainly exceeded 260 pounds, Herr Gerstner, professor of mechanics at the Technical Institute of Bohemia, proposed, in a work entitled "Memoir upon Highways, Railways and Canals." the arrangement represented in Fig. 16 for diminishing the resistance of ordinary wheels. On page 85 of the French translation of this work (1827) it is stated that this apparatus had been constructed and had operated well in the machinery hall of the Technological Academy of Prague. According to the experiments described in this memoir, the tractive force was but a third that necessary with ordinary wheels. This feeble result astonishes us, since in the Atwood machine (formerly classic) for the verification of the laws of gravity, an analogous arrangement gave an insignificant friction.

However this may be, Gerstner's experiment may be considered as the first attempt made to substitute rolling for sliding friction in hubs.

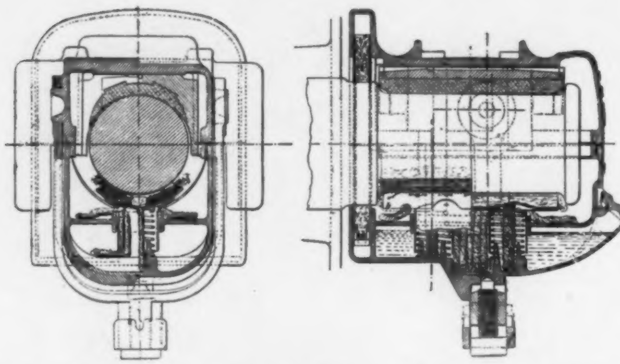
All human industries are linked together, and the progress made in one has a happy repercussion in the improvements made in another. Such has been the case with axle-journals; for ball bearings, like elastic tires, have passed from the bicycle to light carriages.

The coefficient φ then falls to 11 pounds per ton; and it will fall, it appears, to 5½ pounds if between the balls that support the axle there be interposed other and smaller ones so as to cause the disappearance of all sliding friction between the first.

For heavily loaded carriages, ball bearings are not practical, and an endeavor has been made to obtain analogous advantages by substituting rollers for the balls. Several experiments made upon street cars especially seem to have given economic results.

We shall limit ourselves to giving a diagram (Fig. 17) of the roller bearings proposed for heavily loaded vehicles.

Ball or roller bearings seem to be of service for automobile



Figs. 18 and 19. Transverse and Longitudinal Sections of an Axle-Box

carriages, especially at the moment of starting. At this moment, as well known, especially if the stoppage has been somewhat prolonged, the coefficient of the sliding friction of the journals is relatively very high as a consequence of the absence of a lubricant between the surfaces of contact of the journals and the axle-boxes.

On another hand, in the lubrication of the journals, it is necessary to avoid an excess of oil, since then the coefficient of friction, instead of tending to diminish with the speed of relative change of place, tends on the contrary to increase as a function of the square of such speed. It is in order to obviate this inconvenience that railways have discarded oil boxes containing a large supply of lubricating liquid, and have adopted lubricators in which cotton wicks deposit upon the journals just the quantity of lubricant necessary to prevent griping (Figs. 18 and 19).

Many *chauffeurs* to whom we have imparted our fears as to the inconveniences of an excess of lubricant have recognized them as well founded, but have avowed that they far preferred to consume more force than to run the risk of griping. In order to protect themselves against this danger, it would perhaps be of advantage to them, in default of siphon-wicks, to adopt roller or ball bearings in which an excess of oiling has not the same inconvenience, since they substitute rolling for sliding friction.

VI.—Wheels.—From the formulas given for the different stresses to be overcome in the motion of a vehicle, it results that the diameter of the wheels has a marked influence upon the value of the sliding friction of the journal upon the hub, of the movement of the tire upon the roadbed, etc.

As regards this latter factor, that has another effect, since, by virtue of the principle that action and reaction are equal, the wheel impairs the road so much the more in proportion as its diameter is smaller. The classic experiments of Morin and Dupuit permit of no doubt as to this.

In order to diminish as much as possible the stresses to be overcome, it is necessary, then, all things else being equal, to provide the mechanically propelled vehicle with wheels of as wide a diameter as their method of construction, the stability of the whole, the conditions of transmission of motion and the steering arrangement will admit of.

Even before the experiments of Morin and Dupuit, practice and observation had led to giving the wheels of vehicles drawn by animals the largest diameter possible, as may be seen from the following figures:

Wheels of carts......................	about 6½	ft.	diameter.
Hind wheels of the old stage coaches.....	" 5	"	"
Hind wheels of 30-passenger omnibuses..	" 5½	"	"

Upon automobile carriages, on the contrary, the largest wheels reach scarcely 4 feet.

In order to explain this at first sight astonishing tendency of manufacturers, it is necessary to enter into a few details as to the construction of wheels.

The first wheels were made of wood, and consisted essentially of a rim, which was connected by spokes with a hub that revolved around an axle. The rim consisted of a certain number of curved pieces (fellies) connected with each other by dowel-pins and by bands of iron nailed to the external cylindrical surface (Fig. 20). The spokes were assembled with the rim and hub by means of tenons and mortises.

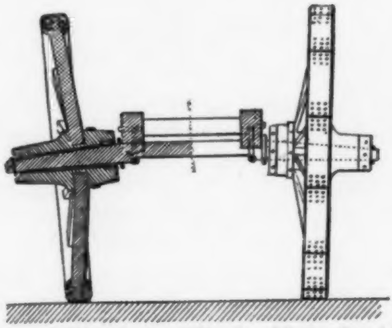


Fig. 20. Old Wooden Wheels with Sectional Tire

In addition to the fact that the wood was liable to warp, this method of assembling offered no lateral resistance. In order to prevent the wheel from becoming contorted through the action of an external blow upon the rim, it became necessary to arrange the spokes, not in a plane, but according to the generatrices of a cone having its apex near the vehicle. The wheel therefore presented what is called a "dish." Figs. 18 and 20 permit of comparing the exaggerated dishing of the wheels used in conveyances in former times and the less pronounced dishing of the truck wheels of the Say Refinery. Under such circumstances, in order that the spokes might come alternately at nearly right angles with the ground, it became necessary to incline the journal, with respect to the axle-shoulder, at an angle just equal to the dishing of the wheel (Fig. 20).

It results from the very method of connecting the rim and hub that the greater the length of the spokes the greater is the distance apart of two consecutive spokes at the rim. Hence, when the wheel is placed in such a way that the two contiguous spokes are symmetrical with respect to the vertical, that part of the rim that separates them tends to flatten so much the more in proportion as it is larger. It is therefore necessary to give it greater dimensions in the direction of the spoke. At the same time that the thickness of the rim increases, its width, and consequently its weight increases. So the weight of the old-time wheels increased very rapidly with their diameters.

Since the progress of the metallurgic industry has permitted of substituting a continuous tire for the separate iron bands nailed to the fellies, it has become possible to diminish the better consolidated rim; but its weight (and consequently that of the wheel) always increases quite rapidly with the length of the spokes, that is to say, with the diameter of the wheel.

The practice of mortising leads to relatively large hubs. In the French Artillery, the wooden hub has for a long time been replaced by a metallic one in which the spokes, pressed tightly one against the other, are held laterally by two bronze or steel cheeks connected by bolts, which, passing through the joints of the spokes, still further increase their stability. This excellent arrangement (Fig. 21) has been adopted by the majority of the automobile carriage builders who have adhered to wooden wheels and have decided upon the use of elastic tires.

Unfortunately, we are still reduced, for the assembling of the spokes and rim, to the necessity of inserting the tenon of the spoke into a mortise in the felly. An attempt has been made, it is true, to interpose metallic sockets, but practice does not seem to

have sanctioned this innovation, by which the weight is increased without any great advantage being obtained. The rim, weakened by the mortises, has therefore to possess greater thickness and width in order to resist a distortion that is so much the more to be feared in proportion as the spokes are more widely spaced, that is to say, in proportion as they are longer.

It is, however, not with a view solely to reducing the weight as much as possible that the builders of automobile carriages shrink before the diameters that theory would require. In a vehicle drawn by an animal the wheels are loose upon the axle, and the sliding friction of the journal upon the axle-box alone hinders the wheel from obeying the movement. The spokes therefore experience but a slight bending strain. In mechanically

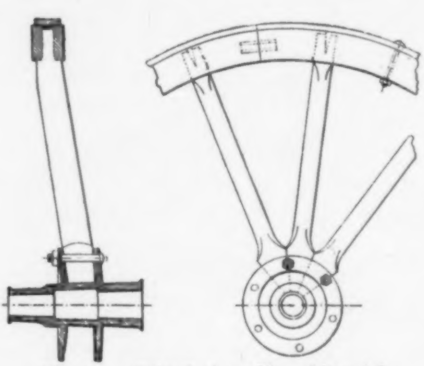


Fig. 21. Wheel of Artillery Material

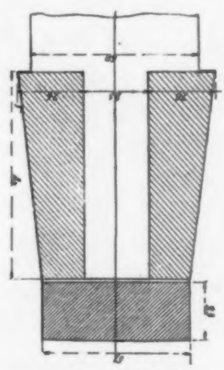


Fig. 22. Section of Tire and Felly of Omnibuses for 30 Passengers.

propelled vehicles, on the contrary, the power is applied to the hub, the resistance is found at the rim, and the spoke is consequently submitted to a bending strain that is so much the greater in proportion as its length is greater.

This reason is not the only one that causes builders to adhere to small diameters, for many have adopted an arrangement which, carrying the application of the motive couple quite far from the hub, diminishes the bending strain of the spokes. Much more than this, one builder, in order to get rid of every cause of such tendency to a flexion of the spokes, has conceived the ingenious idea of leaving the wheel loose upon the journal of the axle, through the hollow centre of which passes a shaft upon which are keyed arms that carry along the rim.

We thus get a glimpse of the possibility of increasing the diameter of the wheels without having to make them of too massive construction. The deviser of this arrangement has not, however, profited by this latitude, and further along we shall see the reason why.

We have said that if a wooden wheel is dished, the journal must present an inclination with respect to the shoulder of the axle. At the outset, manufacturers, desiring to use a chain for transmitting motion to the driving wheel, were afraid that they could not employ this means, if the axis of revolution of the wheel was not exactly parallel with the horizontal shaft carrying the chain sprocket. They therefore adopted plain wheels, without a dish, that were so much the more liable to contortion in proportion as their diameter was greater. In order to obviate this, some had recourse to two series of symmetrically dished spokes; but such wheels are troublesome to keep in repair, since it is difficult to shorten their fellies. At present, it is admitted that it is possible to apply transmission by chain to wheels of which the journal makes but a slight angle with the axle-shoulder.

It is in the fear that these but slightly dished wheels might undergo contortion that must be sought the true cause of the non-adoption of the wheel of wide diameter that the research for the least resistance requires.

We have seen above that the relation that gives the traction T to be exerted in order to cause a wheel of a weight P and a radius R to pass over an obstacle of a height h is:

$$T = P\sqrt{\frac{h}{2R}}$$

The favorable influence of a wheel of large radius springs from this relation, into which $\frac{h}{2R}$ enters; but it is still more efficacious when it is a question, in order to get out of a hole in the road, of surmounting, not a simple stone of a height h, but a paving stone of rounded surface.

Gerstner, in the method cited above, says: "The draught increases so much the more in proportion as the ratio of the distance between the summits of the paving stones to the radius of the wheel is greater. Passing over paving stones is easier with large than with small wheels.

A few incidents that occurred at the competition of Heavy Weights lead us to dwell upon another drawback to small wheels for the running of automobiles upon defective pavements. If the tangent common to the wheel and the paving stone makes

with the horizontal an angle equal to or greater than the angle of sliding friction, the driving wheel, whatever be the power applied to it, will slide if sand be not scattered in front of it in order to increase the coefficient of sliding friction. Now, such a case will present itself so much the more frequently in proportion as the wheel is smaller.

In fact, if we suppose that the load upon the driving wheels or the adherent weight is two-thirds of the total weight, *R* should satisfy the relation:

$$Rf - r + 2\,nl\sqrt{(i^2 + 1)\,\frac{4f^2 + 9\,\varphi^2}{(2f - 3\,\varphi\,i)^2}}$$

in which *R* represents the radius of the driving wheel; *r* the radius of curvature of the paving stones; *n* the number of paving stones forming the depression; *l* the width of a paving stone; *i* the inclination of the declivity; *f* the coefficient of sliding friction upon the paving stone; and φ the coefficient of rolling friction upon the latter.

Many incidents that have occurred in automobile contests have demonstrated this.

As for the alterations in form of the ground, they oppose to the changes of position of the tire a resistance that Coriolis has demonstrated to be:

$$F = \tfrac{3}{8}\sqrt[3]{\frac{3}{mb} \times \frac{P^4}{R^2}},$$

a relation in which *m* is a variable numerical coefficient and *b* the width of the tire.

The obstacle to motion due to the alteration in form of the roadway produced by the too heavy a load imposed upon the wheel therefore diminishes in measure as the width of the tire increases. Consequently, it is of advantage to have a tire of sufficient width to bring the specific pressure (that is to say, per unit of surface) upon the materials of the road to a figure that occasions no sensible displacement therein. Unfortunately, too wide tires, along with the sinuous contours of the path followed, involve relative slidings of the sides of the tires and of the roadway that absorb at least as much live force as the depressions of the materials caused by a tire that is not so wide.

The wear of the edges of tires that are too wide is a manifest proof of this. There is therefore a limit to be determined, and this varies with the state of the road. After continuous rains or thaws have considerably softened the roadbed and rendered the

materials loose, it is necessary to employ wide rims in order to obtain the minimum of resistance. The same would be the case upon sand or plowed earth.

When the roadbed is hardened by frost or hot weather, it is necessary to employ tires as narrow as possible in order to prevent, in curves, a wear of their edges, which is shown by a loss of motive force.

Fig. 22 shows that the Compagnie Générale des Omnibus views the matter in this light, since it adopts for the tire a width less than that which the necessities of the assembling of the spokes and rim would naturally compel us to give the latter. We find this arrangement again in Fig. 15.

It is possible, up to a certain point, to compensate for the looseness of the ground by the flexibility of the edges of the tire. Such flexibility can, in fact, obviate the relative slidings by permitting the tire to yield to the compression that occurs upon the internal edge and to the extension that takes place upon the external one. Besides, an elastic tire is capable of moulding itself upon accidental obstacles and of diminishing the retarding influence of the shocks that it occasions. Thus is explained the reduction of from 20 to 30 per cent. of the resistance to traction and propulsion that experiments with pneumatic tires have permitted of establishing.

On another hand, the deformability of the tires, by diminishing the jarring transmitted to the axles, renders feebler the relative displacements of the axles and the frame to which the motor is fixed. Consequently, the connections between the motor and the driving wheels are of less variable lengths and the force is better utilized. The flexibility of the tire, moreover, would offer another advantage—that of being able to bear at once upon several small projections in the roadway instead of striking against them in succession. Such flexibility can be brought into play only by modifying the construction of the wheel. Instead of connecting the hub with the rim by spokes working by compression, as in wooden wheels, the connections of the rim and hub should be made to work by traction by forming them of wire, as in the bicycle. Here, whatever be the weight bearing upon the hub, it is always possible to adopt sufficiently strong wires, which, working by traction, have need only of the section that is strictly necessary, while wooden spokes, working by compression, must have a section such that they shall not be liable to become sprung.

Another advantage of this method of connection is that the elastic deformability of that part of the rim which is bearing upon the ground deadens the shocks due to stones and jolting.

As the spokes form, as in bicycles, two truncated cones having their large bases at the hubs and their small ones at the rim, a lateral shock upon the tire, as happens in too abrupt a turn against the edge of a sidewalk, will have no more of a disastrous effect than it would upon a dished wheel; while a wheel having spokes in a vertical plane would be shaken.

Now that, upon many tramways, guard-rails are not employed, by reasons of economy, wooden wheels with a single series of dished spokes perhaps no longer suffice. The wheel with a double series of metallic spokes with a symmetrical dish should offer an advantage as being able to resist shocks in all directions. Such spokes should be tangent to the hub in order to resist better the moment of torsion that tends to occur from the hub to the rim when the tire of a wheel keyed upon the axle or carried along by a toothed wheel fixed to the hub is abruptly arrested or impeded in its motion by a stone or any other obstacle. For a backward motion the spokes must be arranged symmetrically with respect to the radii. The method of fixing these spokes to the hub and rim constitutes a question which, although one of detail, is none the less of great importance, since the frequency with which damages occur and the ease with which they may be repaired depend upon it.

Wheels of which the hub is connected with the rim by metallic spokes lend themselves wonderfully well to the adoption of a tire sufficiently flexible to apply itself to the roadway for an appreciable length.

These flexible tires can be arranged in two ways—either in the interior or upon the exterior of a rubber tube secured to the rim. The first system, which was tried for bicycles, consisted of iron wire. It does not seem to have succeeded in this form. Theoretically, it presents so many advantages that it is to be desired that some experiments shall be made in replacing the wire of the bicycles by a band of steel for automobile carriages.

M. Jeantaud has patented a metallic tire connected with the rim by a rubber tube. He hopes thus, without any pecuniary expense due to the rapid wear of the rubber upon the roadway being involved, to obtain a few of the advantages of the elastic tire, and principally the advantage offered by those slight lateral movements of which we have already pointed out the consequences. It is true that his tire is not flexible, but there is nothing to prevent him from making it so; although such an improvement would require the substitution of metallic spokes for wooden ones. Theoretically, it ought to be thus with pneumatic tires, since under the action of compression, the air driven

from the bottom of the tire is forced toward the top and tends to superelevate the tire and consequently the wheel itself.

VII.—SUSPENSION—As to the utility of suspension, that is to say, the interposition of elastic parts between the frame of the vehicle and the wheels submitted directly to the shocks of the road, there can be no doubt, as regards the comfort of the passengers or the preservation of the motor fixed to the frame. It is well to assure ourselves whether the same is the case from the view point of the total resistance to be overcome. We know, in fact, that Dupuit, during his studies upon the running of vehicles,* found that the coefficients of traction of a ton were respectively:

	Metalled Roads.	Paved Roads.
Non-suspended Carts......	66 lb.	37.5 lb.
Suspended Stage Coaches	66 "	44 "
Suspended Private Carriages	79 "	74.75 to 81.5 "

Nevertheless, in the resumé of his experiments, this engineer asserts that although upon even surfaces, hard or soft, the resistance to rolling is independent of the speed and suspension, such resistance, upon surfaces that are uniformly rough, increases with the speed in carriages that are not suspended, but that this increase is diminished by the suspension so much the more in proportion as the speed is greater.

This assertion of Dupuit is of the highest importance for automobile carriages, the object of which is to satisfy the need of going fast.

Dupuit's experiments made it plain that in measure as the load placed upon the suspended part of the carriage increased, the numerical value of the force of traction diminished. Since the non-suspended part of the vehicle (wheels and axle) preserved a constant weight, Dupuit was led to conclude that the interposition of suspension notably diminished the draught.

The increase of draught mentioned at the beginning is therefore not due to suspension, but to the vibrations of the accessory parts of the stage-coaches and private carriages that are transmitted to the air in producing sonorous waves, and that increase with the speed of translation, that is to say, with the number of shocks in a unit of time.

This is one of the reasons why pneumatic tires, which are anti-vibrators par excellence, produce a diminution in the draught.

Professional men had no need to await Dupuit's experiments to perceive that suspension diminished the loss of a portion of the motive force consumed by shocks against the protuberances

* Essais et experiences sur le tirage des Voitures, Paris, 1837.

of the road. As long ago as 1832, Schwilgué said*: "It is useless to dwell upon the advantages presented by the use of springs in carriages. They are now completely demonstrated. We know that they consist not only in rendering the motion of carriages gentler, but also in *diminishing the surface-wear of roads and in saving a notable portion of the motive force.*

From the moment that the suspension of frames becomes capable of diminishing the total resistance, we should carefully study what conditions it should fulfil in order to realize this object. In a carriage, whether it be horse-drawn or mechanically propelled, the motion is never uniform, but is continually varying. Consequently, if the mass in motion be capable of oscillating around a centre of rotation, the straight line passing through its centre of gravity and through the centre of oscillation will tend to make with the vertical an angle α, such that $\mathrm{tg}\cdot\alpha$ will be equal to the acceleration of the motion that the mass tends to produce.

It is only when the motion is uniform, that is to say, when the acceleration is null, that this angle α is equal to that which the vertical makes with the line at right angles with the surface upon which the carriage is placed.

The object of a rational suspension should be to permit the mass of the vehicle to assume this position of equilibrium and prevent the inertia of the carriage from intervening in the shock against the obstacle opposed to the motion of the vehicle.

There are accelerations in the transverse, as well as in the longitudinal or vertical direction, since both wheels of the same axle can never meet with the same conditions of rolling simultaneously. It should therefore be possible for the suspension to permit the vehicle to oscillate in a transverse direction as well as in a longitudinal or vertical one, without, however, interfering with the transmission of the action of the motor to the axles.

Let us, in the first place, consider the suspension in a two-wheeled vehicle drawn by an animal or by a man. The motor must, through an elastic connection, be protected against the jerking motion resulting from the protuberances of the surface of the ground. The interposition of elliptic springs between the shafts and the axle would satisfy this desideratum, from the standpoint of the vertical displacements of the load; but to a less degree as regards the longitudinal displacements, and very slightly as regards the vertical ones. Therefore, it must be avoided; especially in vehicles drawn by man, since there would

* Annales des Ponts et Chaussées, 1832, 2d semestre, p. 231.

result jerks upon the arms, of which deliverymen would complain, such jerking motions may be diminished by substituting springs formed of a single plate for the elliptic ones; since, with such an arrangement, the plates of the spring, forced to bend in order to submit to the transverse oscillations, will sufficiently diminish the transverse jerks transmitted to the shafts. But, since in such a case the variations in the curvature of the spring produce different horizontal distances between its two extremities, the connection of the posterior extremity with the shaft must be movable along the latter.

In some hand-carts, the posterior extremity of the spring-plate is passed by hard friction between two rollers fixed to the shaft, and extends beyond the latter to the distance necessary. In most cases, this extremity is connected with the shaft through the intermedium of a link suspended from a bracket.

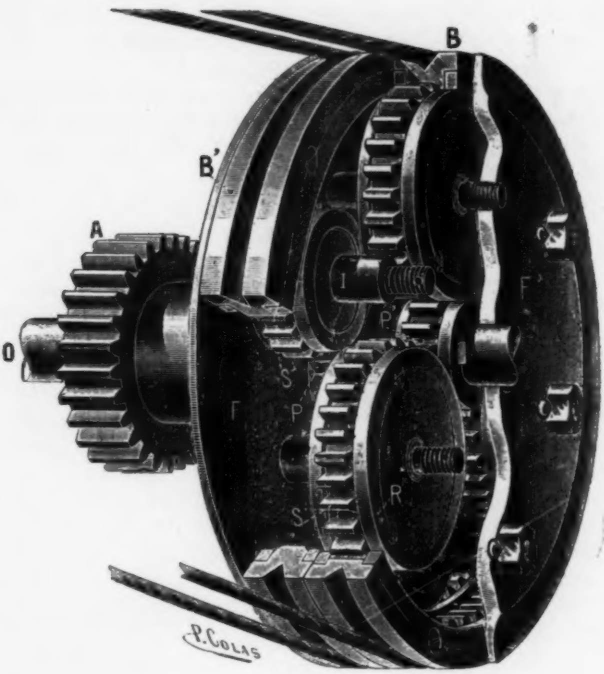
When the cart is to move at the speed of a trot, at least when empty, the posterior part of the spring, instead of being fixed to the shaft, is left free, and, through a double link, there is suspended from it a transverse spring-plate, upon the centre of which the axle bears.

Sometimes the shaft is connected with the axle, as in the tilburys of the Administration des Postes. In these vehicles the body is independent of the shafts and is supported by the centres of two transverse springs connected by links with the longitudinal springs fixed to the axle. Under such circumstances, the transverse oscillations of the body, quite heavily loaded, would take on dangerous amplitudes were they not kept within proper limits through straps of a definite length fixed to the body and shaft.

To the suspension of these tilburys, we should much prefer that of certain pleasure wagons of the best constructors, or of some of the vehicles used by bleachers. The frame that prolongs the shafts is connected with the axle through longitudinal springs formed of a single plate. The body is suspended through two transverse springs connected with the frame through links arranged in such a way as to allow of a variability in length, while at the same time assuring an equilibrium of the body.

It is well to remark that, in this rational suspension of the two-wheeled vehicle, the action of the motor is transmitted to the axle through the front part of the longitudinal spring, which then operates by extension. The connection of the front part of the spring with the frame must therefore be made through a simple roller, and not, as in some vehicles, by links.

Specially translated for the Automobile Magazine from *Le Génie Civil.*



A Progressive Change of Speed

THE new change of speed devised by M. H. Gerard, and represented in section in the accompanying engraving, is a progressive apparatus of simple construction in which are grouped several ratios of speed, each of which is obtained through an epicycloidal train of which the gearings are always in engagement.

The type that we figure herewith is designed to afford two speeds, that is to say, it comprises two trains, each of which consists of: (1) A central pinion, *P P'*, keyed upon the driving shaft; (2) three spur-wheels, *S S' S''*; and (3) an internal gear, *B B'*, the periphery of which is provided with a groove for the reception and guiding of the brake.

The axles, *I*, of the spur-wheels are secured to the external plates, *F F'*, one of which, *F*, carries at the extremity of a

socket a pinion, *A,* that meshes with the toothed wheel of the differential and transmits motion to the driving wheels. The gear wheels of each train are supported and held at an immutable distance by revolving disks, *R,* fixed laterally.

When the motor is in operation, one of the brakes renders one of the internal gears immovable, and the central pinion keyed upon the driving shaft revolves the spur-wheels, which, taking a purchase upon the stationary internal gear, carry along the axles, external plates and pinion *A* at a differential speed that depends upon the ratio of the gearings. The other train will remain idle; and one speed will be obtained. When the second train is rendered immovable, the first will be freed; and, as the ratio of the gearings is different, we shall have a second speed.

When the two brakes are free, the pinion *A,* the plates *F F′*, and the axles will remain stationary as a consequence of the resistance of the carriage, and the spur-wheels will revolve, along with the internal gear, in a direction reverse that of the running of the motor. The driving mechanism will thus be thrown out of gear.

With this apparatus, it is possible to throw the mechanism into gear progressively and with the greatest ease, without any fear of stalling the motor (even on a declivity); to change from one speed to another, and to throw the mechanism out of gear without the least shock and as gently as may be desired, since the braking of the speeds is dependent upon the will of the driver.

There is no danger of a breakage of the cogs, since the gearings are always in engagement. Moreover, the disks that support such gearings prevent the cogs from meshing too deeply and becoming wedged, and constitute rollers that have the same effect as a ball-bearing mounting, in rendering the revolution of the wheels easy, and in suppressing noise and wear. Consequently, the work absorbed may be considered as null.

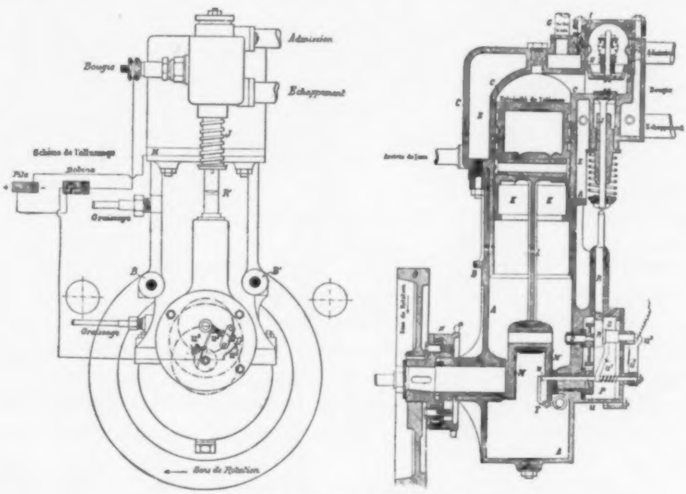
A SOCIETY VEHICLE

Mrs. John Jacob Astor is the first woman to use her own brougham automobile for social events. It is a beautiful vehicle, exquisitely lined in blue satin, and, with its liveried driver, is quite a show. At the Pell-Morris wedding the turnouts were all exceedingly handsome, but Mrs. Astor's carriage was the most admired.

It is light-looking in appearance, and has none of the "buzz" so frequently heard in autos.

The Partin Motor

THE Partin motor presents many peculiarities of construction, most of the details of which may be easily understood, without any extended description, by a reference to the legend placed beneath the sectional views given in the accompanying Figs. 1 and 2. Nevertheless, it may be well to



The Partin Motor

A, Frame; BB^1, Points of Attachment of the Motor; C, Double Jacketed Cylinder; E, Water Chamber; F, Water Supply Pipe; G, Water Discharge Pipe; H, Automatic Suction Valve; I, Cover of the Valve-box; J, Exhaust Valve; K, Piston; L, Connecting Rod; MM^1, Crank; N, Starting Gear; O, Fly Wheel; P, Pinion that Controls the Cam-shaft; Q, Cam-shaft; R, Exhaust Cam; R^1, Rod of the Exhaust Valve; S, Ignition Cam; T, Regulator Lever; U, Shaft that Carries the Ignition Lever and Vibrator; U^1, Ignition Lever; U^2, Vibrator; U^3, Contact; U^4, Insulator; V, Ignition Tube.

say a few words in regard to some of the characteristic parts, such as the valve-box, for example.

This is so arranged that the interior may be easily inspected and the valves be taken out and replaced without disturbing the intake and exhaust pipes located at the side of the box. All that has to be done is to unscrew two nuts and remove the cover, *I,* when the seat, *H,* of the admission valve, along with the valve itself, may be readily taken out. The exhaust valve will then

be exposed to view, and may likewise be dismounted after the simple removal of a key.

The arrangement for automatically regulating the ignition is likewise very simple. Upon one of the arms, *M'*, of the crank is pivoted the regulator lever, *T*. One of the extremities of this is kept in contact with the shaft *U* by means of a spring, while the other extremity carries a counterpoise.

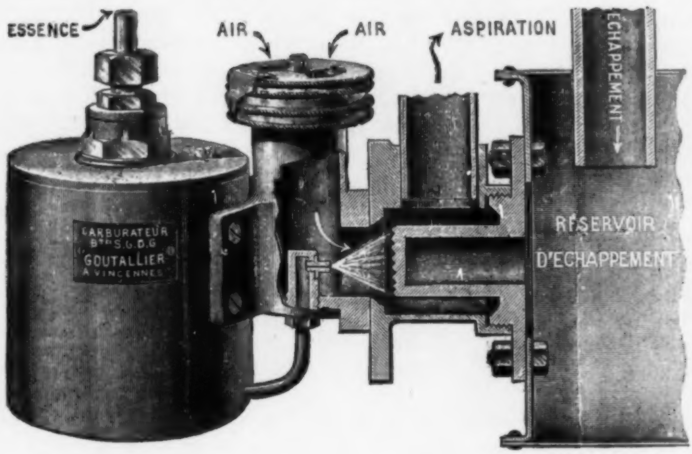
The shaft *U* is capable of moving in a rectilinear direction under the action of the centrifugal force exerted by the counterpoise. In case the rotary velocity of the crank-shaft should become excessive, this rectilinear motion would displace the lever *U*, which is in contact with the ignition cam, *S*. This latter is provided with a diagonal groove of 45° into which the point of the lever U^1 enters at every revolution. The result is that its point of attack varies according to the place occupied by the lever U^1 with respect to the diagonal groove; the variability being caused by the thrust of the counterpoise. The attack of the cam *S* at any point whatever produces at the time at which it occurs a contact of the vibrator, U^2, with the contact terminal U^3; and a wire running from this to the induction coil, and thence to ignition tube, *V*, ignites the explosive mixture. As the ignition has been retarded for a moment upon the ordinary point, the explosion possesses a dynamic force less than its maximum, and this diminishes the velocity of the motor.

The duration of the attack upon the cam is invariable, but the moment of the attack varies according to the position of the lever U^1 upon the cam *S*.

The part of the cylinder in which the explosion takes place is provided with a double jacket, *C*, within which circulates a quantity of water. The vapor produced by the liquid goes to the radiator, where it becomes condensed and then returns to the reservoir, *E*, and so on, until an exhaustion is produced by the vapor that cannot be condensed and that escapes into the open air.

AN AUTO WHEEL-CHAIR

The latest development of the electromobile is in the form of an invalid's chair. A Toronto electrician is said to have designed an electromobile for this purpose, carrying a four-horse-power motor and sufficient battery capacity for a fifteen-mile run at four and a half miles per hour.



The Goutallier Carbureter

IN constructing the carbureter illustrated herewith, the object that M. Goutallier had in view was to obtain a carburation that should be always uniform. The apparatus consists of a reservoir of constant level from the interior of which the gasoline is led by a tube to a small horizontal capillary ajutage. At the time of the admission, and by reason of the vacuum formed behind the piston, the gasoline escapes from the ajutage with force and impinges against a striated wall, which, from the fact that it forms the bottom of a conduit connected with the chamber that receives the residual gases of explosion, is kept at an elevated temperature.

The gasoline is therefore not only atomized, that is to say, reduced to the state of very minute drops, in suspension in the air, but is also gasified through the elevation of temperature to which it is submitted in coming into contact with the striated wall.

A proper quantity of air enters in the direction shown by the arrows, becomes thoroughly mixed with the gasoline vapor, and forms therewith a detonating mixture that reaches the motor through the admission tube. The quantity of air that is to enter is regulated at the outset once for all, and does not have to be varied during the operation of the motor.

At the bottom of the admission tube there is arranged a sheet of wire gauze, which subserves two purposes: first to blend the constituents of the explosive mixture intimately and form a very homogeneous whole; and, second, to prevent returns of flames to the carbureter—an accident, however, which would not have a very great influence in the present case, because of the very small quantity of explosive mixture that the apparatus contains at any given moment.

In carbureters in which, above the level of the gasoline, there is stored a large quantity of carbureted air capable of igniting and causing an explosion, the use of the wire gauze is absolutely indispensable; but, in apparatus of the type under consideration, such is not the case. Even an ignition of the gasoline need cause no alarm, since, should such a thing occur, the fire would be quickly extinguished for want of the air necessary to support combustion.

What will be especially remarked in the Goutallier carbureter is the ingenious arrangement that does away with the heating tube, which is always in the way when the apparatus has to be dismounted, and also with the necessity of regulating the hot and cold air.

The apparatus can be readily dismounted by the unscrewing of three nuts only, and by means of one and the same wrench.

AUTOCARS AT ENGLISH COUNTRY HOUSES

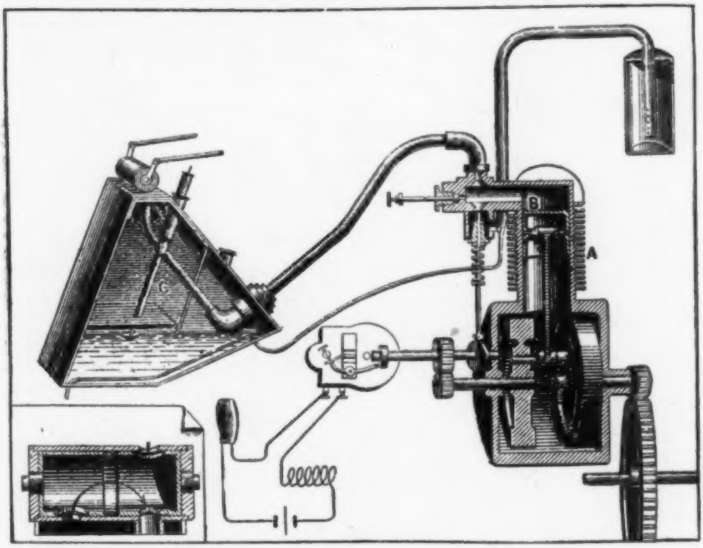
Lord Iveagh, according to the London *Daily Mail,* has a number of motor vans, lorries and carriages at work on his estate. The Duke of Westminster has a car which is used for station work. The Hon. Evelyn Ellis uses cars for station work and uses one of his motors for fire-engine and garden-hose purposes. Lord Montagu of Beaulieu and many other people have motor wagonettes for station duty and for the conveyance of beaters during the shooting season.

The Automoto Motor

THE automoto motor, which came into prominence at the last Exposition de la Salle Wagram, and which, as may be seen from the perspective view given in Fig. 1, bears considerable resemblance to the De Dion motor, is of 2¼ H. P., and of the four cycle type.

The cylinder, *A* (Fig. 2), is vertical and provided with numerous cooling flanges cast in a piece with it.

The admission valve operates in a box placed at the upper part of the motor, and is held upon its seat by a spiral spring.

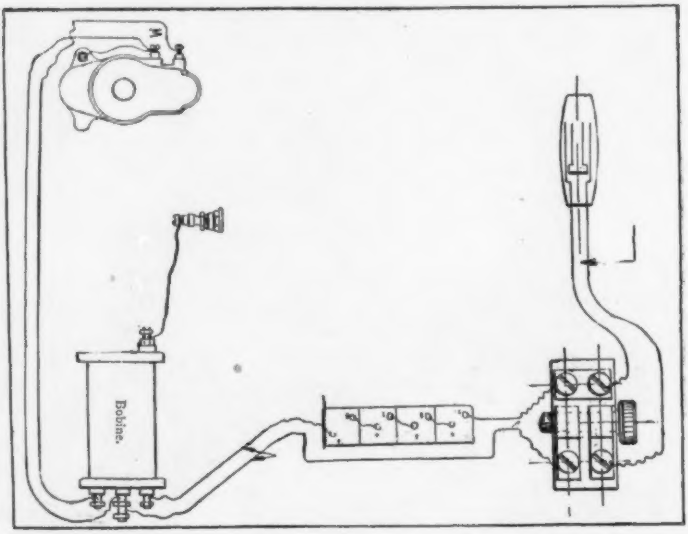


The residual gases of explosion are expelled through the lifting of a valve controlled by a cam to which motion is imparted by a pinion that revolves at a velocity half that of the motor shaft.

The lubrication is accomplished by means of the splash system. A quantity of oil, having been poured into the casing, is scattered by the flywheel over the sides of the piston and the walls of the cylinder, which are thus sufficiently lubricated.

The carbureter, which may be seen to the left in Fig. 2, is of the surface type, and offers no peculiarity worthy of description.

The admission tube and carburation cock are provided with disks of wire gauze in order to prevent back flames from entering the carbureter at the time of the explosion. In fact, in carbureters of this kind, which are of relatively large size, there exists a considerable quantity of explosive carburets which the least flame would suffice to detonate and cause numerous accidents, of which the least would be the ignition of the gasoline contained in the carbureter. The object of the wire gauze is to avert such accidents by cooling the flame sufficiently to extinguish it. It is an application of the principle upon which the miner's lamp is based.



The ignition is effected by means of an induction spark. At the proper moment, and at every two revolutions of the motor, a cam mounted upon the secondary shaft actuates a small lever, which closes the primary circuit. When the cam disengages this lever, the latter is abruptly pulled back by a spring, and thus breaks the circuit. The induced wire is then traversed by a current of high tension which produces a spark at the igniter.

The primary circuit is supplied by batteries or accumulators. Fig. 3 shows the wire arrangement that the manufacturers of the motor recommend.

A wire starting from the negative pole of the battery runs to the handle bar and then passes into the left grip, which performs

the function of an interrupter. It afterwards returns to an interrupter placed in the middle of the handle bar, and thence runs to one of the terminals, *M,* of the coil.

Another wire, starting from the positive pole of the battery, runs to the terminal, +, of the coil.

From the coil there start two other wires, one of which, connected with the terminal *M,* already mentioned, runs to the terminal, *M,* of the igniter, while the other, connected with the terminal, *F,* of the coil, runs to the terminal, *T,* of the igniter.

A fourth wire starts from the single terminal, *B,* of the coil and is fixed to the igniter.

The primary circuit is therefore as follows: the battery, the grip, the contact screw, the vibrator, the primary coil, and return to the battery.

The ignition controller, that is to say, the piece that carries the contact lever and contact screw, is capable of revolving around the axis of the cam, which so actuates it as to permit of causing variations in the periods of ignition.

The normal velocity of the automoto motor is from 1,400 to 1,800 revolutions a minute.

A New Form of Tire for Automobiles

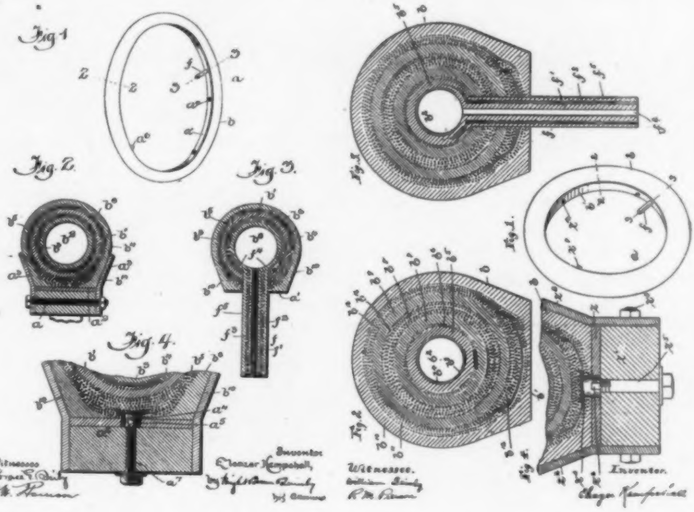
ONE of the most pronounced defects in the structure of the pneumatic tires commonly used on automobiles is the lack of any reinforcing backing for the air-chamber. It has often happened that weak spots in the tube have been pressed out in the form of nipples by the inflated air-chamber; for the pressure is practically concentrated at the defective portions, thereby bursting the tube. Our attention has been directed to a very efficient form of compound tire invented by Mr. E. Kempshall, in which a supporting backing is formed about the tube, which backing limits the outward movement of the tube to a predetermined extent and prevents air from forcing the material beyond a definite point.

Fig. 1 is a general view of the tire. Fig. 2 is a cross-section on the line 2, 2 of Fig. 1. Fig. 3 is a cross-section on the line 3, 3 of Fig. 1 and shows the air-tube, the valve, and the method of combining the two. Fig. 4 is an enlarged detail, representing the location and arrangement of the plies composing the fabric tubes and the manner of securing the tire in place on a wheel-rim.

The tire consists essentially of an inner yielding member b^3 formed of rubber and provided with an air-chamber b^2. The rubber member b^3 is confined and backed by an inner tube b^4 of reinforcing fabric. The outer, inclosing envelop of the tire is composed of a rubber facing b^{10} vulcanized upon a heavy fabric backing b^{11} made of duck. The several plies of this fabric are wound about the tube and the ends joined or spliced on the inner side of the tube, thus maintaining the uniform strength of the exterior or wear side. Between this outer, inclosing envelop and the inner air-chamber is a compound cushion of rubber which absorbs the motion. The compound cushion is interposed between the fabric backing b^6 and b^{11} and is composed of a multiple-ply tube b^8 of heavy duck, a motion-absorbing cushion of rubber b^7, and a second motion-absorbing rubber cushion b^9.

The rubber tube b^5, surrounding the backing b^4 of the air-chamber, forms the core f' of the stem. The core, as shown in Fig. 3, has an air-passage f^2 communicating with the air-chamber b^2 of the tire. A multiple tube f^3 of fabric surrounds and reinforces the core; and one or more plies of the tube f^3 are extended

into and anchored to the material of the tube b^5. A strong facing of rubber f^5 is applied to the tube f^3, which facing constitutes an extension of the tube b^5 and is integrally connected with the superimposed parts. The fabric backing f^3 of the stem protects the core f' from strains due to the pressure of the air upon the usual valves secured to the end of the stem. Since the fabric backing is anchored in the interior of the tube b^5, and since the rubber facing f^5 of the valve is a continuation of the rubber of the tube b^5, it follows that any strain upon the valve-stem is borne



by the fabric backing f^3, thus leaving the wall of the air-chamber f^2 free and enabling it to perform its proper duty of stopping the passage of air.

The tire has a general oval shape and is formed with a flat inner face b', fitting upon the correspondingly-formed metallic rim x'. Lugs x^4 are secured to the inner face of the tire and are provided with central apertures, which receive bolts x^5 passing through the rim and binding the tire in place. Flanges x^2 bolted to the rim prevent the lateral displacement of the tire.

The air-tube, valve-stem, together with the rest of the tire, are built of green stock and vulcanized into an integral structure, instead of being made and vulcanized separately.

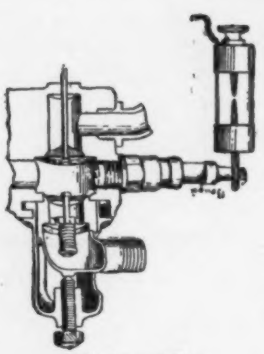
The compound cushion of rubber protects not only the wheel from injury caused by blows, but also the tubes from being rup-

tured by the strain to which a tire is naturally subjected. The rubber cushion yields both laterally and longitudinally to give the tubes the necessary play. The walls of the tire are of such thickness and are so protected by the canvas that it is well-nigh impossible to puncture the tire far enough to reach the air-chamber. Should the air-chamber be punctured, its small diameter, coupled with the thick backing, will cause its walls to meet before the tire can collapse materially.

Electric Spark Indicator

THE apparatus figured herewith shows the driver of an automobile, at a glance, the behavior of the electric spark in the explosion chamber, by causing a reproduction of it outside of the motor, and in the interior of a small glass tube mounted upon the igniter.

The apparatus consists essentially of two insulated metallic rods placed in the centre of the tube and fixed to the top and bottom caps of the latter by one of their extremities, which is threaded so as to permit the distance apart of their tips to be regulated.



Half Actual Size

One of these rods is secured to the igniter, and the other to the wires of the induction coil by a very simple arrangement.

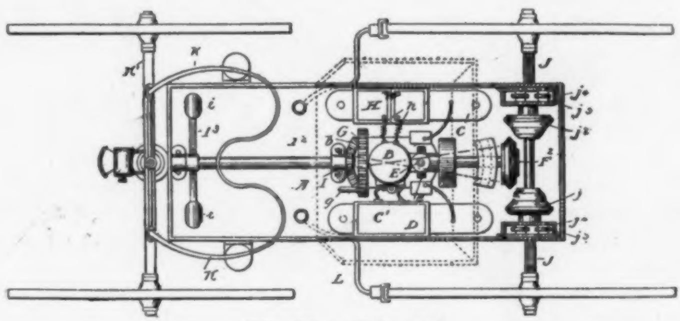
There is no danger of the occurrence of a fire, since the spark produced is protected on all sides from contact with external objects.

As the apparatus remains permanently fixed to the igniter, it allows the driver, while on the road, to keep himself constantly informed as to the working of the ignition apparatus, and thus to avert the necessity of occasionally dismounting and remounting the wires of the igniter and the igniter itself, and consequently to avoid stoppages of his carriage. It permits, too, of noting the length of the spark, and thus tends to prevent the occurrence of those electric shocks that sometimes give the heedless automobilist a painful reminder of the physiological effects of a high tension current.

The Plass Voiturette

IN the Plass voiturette, recently patented in this country, it has been the object of the inventor to reduce the parts to their simples expression, so that the maneuvering thereof may be rendered easy and capable of being effected by anybody.

In the body, *A*, of the vehicle, and directly beneath the seat, is placed a gasoline motor, *B*, on each side of which is situated a reservoir, *C*, from which the gasoline is withdrawn by a pump, *E*, that sends it to the explosion chamber. In front of the motor there is a spur-wheel, *G*, which gears with a pinion keyed upon the shaft *F*. This arrangement permits the driver to start the motor by acting upon the winch *g* of the wheel *G* with his hand.



The Plass Voiturette

The ignition is effected through the intermedium of the batteries *H*.

The motor is capable of revolving upon a pivot, *B*, which is integrally formed with the circular base, B^3, upon which the engine rests. This base is provided in front with a toothed sector, *b*, which gears with a pinion, *I*, keyed upon the shaft I^2. This latter is provided with a cross-piece to which are secured pedals, *i*.

The driving shaft, *F*, is provided in the rear with a friction cone, F^2, which is capable of transmitting motion to two other friction cones, $j\ j^2$, keyed upon the hind axle of the vehicle. These two last-mentioned cones are stepped, so that when the driver bears upon one or the other of the pedals, *i*, in order to cause the motor to revolve upon its pivot, B^2, and throw the cone

F^2 into engagement with one of the two cones j j^2, he can obtain a variation of speed dependent upon the degree of pressure exerted.

The driving axle is mounted upon rollers, j^3, that revolve in boxes, j^4, arranged on each side of the body *A*.

The steering is effected through the intermedium of a belt or guide, *K*, the extremities of which are attached to the handle-bar.

Two brakes, *L*, jointed at *I*, under the carriage body, are so arranged that they can be actuated by the driver's feet.

The "Eole" Voiturette

THE "Eole" Voiturette is a small quadricycle provided with a 2¼ horse-power Aster motor placed in front, between the two steering wheels, and well exposed to currents of air. Alongside of it is placed the carbureter. The arrangement recalls that of tricycles.

To the exterior extremity of the driving shaft, towards the axis of the carriage, is keyed a sprocket, which, through a chain, controls a toothed wheel fixed upon an intermediate shaft that carries a sprocket which is loose upon it, but capable of being connected to it through the intermedium of a drum and a spring plate after the manner of a band brake that can be tightened at will; the whole constituting a sensibly progressive engaging and disengaging coupling. This sprocket, in turn, controls, through a chain, a toothed wheel fixed to the differential gear mounted upon the axis of the driving axle.

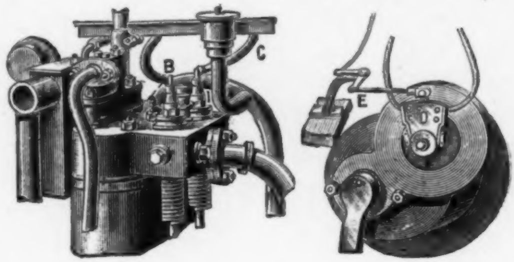
The intermediate shaft is placed near the centre of the carriage, parallel with the axles. All the parts are placed under the floor. The two transmissions constitute a double reduction gearing; the motor revolving with greater velocity than the hind wheels. The changes of speed are effected, as in a tricycle, by acting upon the explosive mixture and the igniter.

Before long we shall have a model allowing of two speeds. The second speed, however, is not necessary in the type provided with two coupled Aster motors both placed in front.

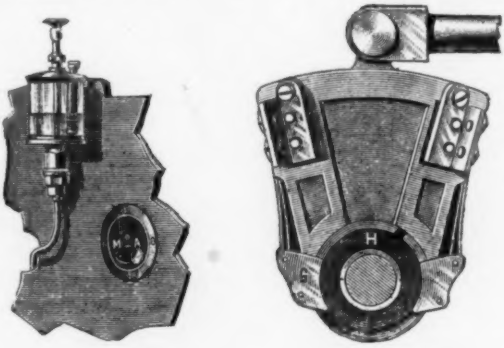
This carriage, properly suspended, weighs, when empty, about 440 pounds. It is capable of carrying two passengers seated side by side.

Electric Ignition in the Phœnix Motor

AFTER the application of the method of igniting the explosive mixture of hydrocarbon motors by means of an electric spark shall have superseded the use of incandescent tubes and become universal, the automobile industry will have made a great stride. The recent application of this method,

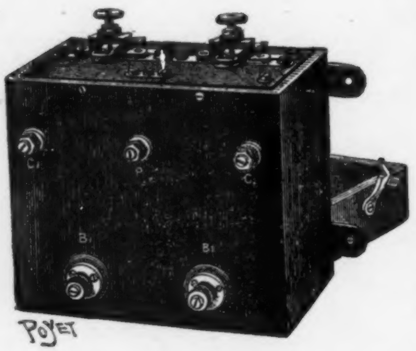


in a new form, to the Phœnix motor, by the Société Commerciale d'Automobiles, has proved so successful that a brief description of the arrangement adopted will not be devoid of interest.



In the accompanying illustrations, Fig. 1 shows the position of the igniters, *B*, which are placed upon the explosion chamber on the side opposite that of the exhaust valve. Fig. 2 represents the accumulator interrupter, which is placed alongside of the

sight-feed lubricator upon the dashboard of the carriage. Fig. 3 gives the details of the ignition controller, and Fig. 4 a general view of the same placed upon the cam shaft that controls the exhaust valves. *E* is the rod by means of which the driver transmits the accelerating or retarding motion to the ignition controller. Fig. 5 shows the box that contains the double coil, and which, along with the accumulator, is placed in the box of the carriage.



Of the two wires that start from the accumulator, one ends directly at the coil, while the other runs to the interrupter fixed to the dashboard of the carriage, opposite the driver, and consequently within easy reach of his hand.

The two wires that start from the terminals of the double coil end at the two terminals of the apparatus (Fig. 3) that controls the ignition. This apparatus consists of two tempered steel contacts, *G*, which are mounted upon springs and rub against a circular band of fibrous material surrounded by a phosphor-bronze ring. This latter is interrupted at two points, and the section thus insulated is put in connection with the body of the motor by means of a screw that traverses the band of fibre and flattens out against the distributing shaft.

Two small grease boxes placed above the pieces *G* assure the lubrication.

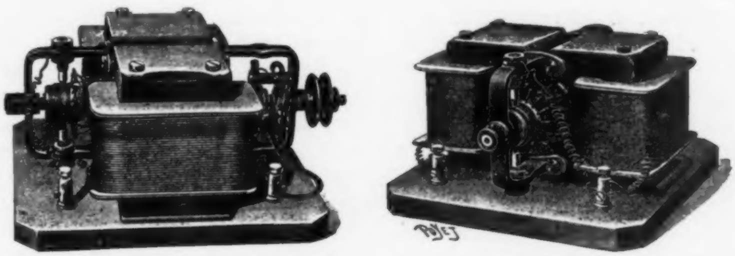
Two insulated wires connect the binding posts, B^1 and B^2, on the exterior of the box containing the coils with those of the igniters, *B*, arranged upon the explosion chamber.

The speed of the carriage is changed by varying the position of the ignition controller (Fig. 3) upon the cam shaft. The motion to effect this is transmitted from the driver's seat through the rod *E* and a bell crank.

Transformer for Charging Ignition Accumulators

By A. Delasalle

IGNITION in hydrocarbon motors is at present accomplished in two ways: (1) by incandescence, and (2) by electricity. From the standpoints of neatness and the ease with which the carriage is set in motion without loss of time, the advantages of the last-named process are indisputable; and, much more than this, it permits the ignition to be effected with greater facility than does incandescence. But, although its advantages are great, it is attended with inconveniences that must not be left out of



The Legros and Meynier Transformer for Charging Ignition Accumulators

consideration, and these the partisans of incandescence never fail to harp upon at every opportunity.

The spark is obtained through a current furnished by a generator of electric energy, and is then transformed in a coil of the Ruhenkorff type, which gives the secondary circuit the current of high tension that is necessary for the production of the spark. The generators now employed belong to one of three categories: (1) batteries; (2) accumulators; and (3) magneto-electric machines. Up to the present, there exist but a few applications of the latter type, and this is a fact to be regretted, since the magneto-electric machine is most reliable apparatus. We have to deal, then, with batteries and accumulators only. Each of these kinds of apparatus has its friends who find therein every good quality and but few defects. That batteries are excellent is undeniable; but only so long as they operate. When, to use

a common expression, they become "dead," there is nothing to be done but to buy others. This, perhaps, is an inconvenience to the purchaser, but not to the manufacturer, who does not make presents of the apparatus!

Moreover, batteries possess an electro-motive force which is inferior to that of accumulators, and consequently a greater number of them is required; and the number has to be increased, too, because of their great internal resistance.

Accumulators are in like manner costly, but, after they are discharged, all that has to be done is to resupply them with the quantity of electric energy that they have given, rendering, of course, excepted. From the viewpoint of inconveniences, the objections made to the accumulator are its want of tightness, its sulphatation and the short circuits that occur between the plates. But let us examine these different objections: It is quite true that there is a want of tightness when it is a question of ebonite boxes; but when the boxes are of celluloid, with a tight cover and special plugs, it is rarely the case that the quantity of liquid capable of escaping is great enough to do any injury. For tricycles, indeed, there are elements provided of which the electrolyte is rendered immovable; but, up to the present, we know of no liquid rendered solid that is really serviceable. The best, that made by the Schoop process from silicate of soda and sulphuric acid, is far from being what is claimed for it.

As for sulphatation, that is very simple. All that the driver has to do is to take good care of his battery, and avoid discharging it below the voltage indicated in closed circuit, that is to say, when the voltmeter marks 1.8 volt per element—the motor being in operation. If this matter be carefully attended to, the chances are that there will be no sulphating of the accumulator; and it is to the too often repeated sulphatations and desulphatations that is due the fall of active material that produces contacts between the plates. The fact must be admitted that sometimes, too, such an accident is due to defective manufacture; but the matter is purely accidental. Upon the whole, the accumulator is a good, but delicate apparatus, and one that requires to be taken care of, since the lightness that is demanded of it necessarily involves a lack of strength.

After the accumulator has fallen to 1.8 volt, it has to be recharged within as short an interval of time as possible. If the owner has not a dynamo machine or an electric supply station at his disposal, he may employ Bunsen or bichromate batteries; but only in cases in which it is absolutely impossible to do otherwise, seeing how difficult it is to obtain a regular current, and how

disagreeable and costly is the manipulation of batteries. In some cases, drivers have their recharging done by electricians, or those called so, who overtax their apparatus, and in others (and this is the better plan) have the work done at some responsible charging station or by some manufacturer of accumulators. But, with an element of 20 ampere-hours capacity, at a discharge of 0.8 ampere, this costs from 25 to 35 cents; while with others of a capacity of 50 ampere-hours, at the same rate of discharge of 25 hours, the cost is 60 cents. All that remains to be done is to take the charge from the public distributing circuits, if the driver has at his disposal a means of making a connection therewith.

The majority of automobilists own two batteries of two elements. If we suppose that both together are charged upon a 110-volt circuit, the current being one of 2 amperes, and the operation lasting 10 hours, for example, the battery will be furnished with a quantity of electricity amounting to 2 amperes × 10 hours = 20 ampere-hours.

The difference of potential at the terminals of one element during the charge will vary from 2.3 volts at the beginning to 2.5 at the end of the operation. The mean difference of potential, or, in other words, the mean ordinate of the curve of voltage, will be in the vicinity—2.42, which will give 2.42 × 4 = 9.68 volts for 4 elements in tension, and a work furnished of 20 × 9.68 = 193.6 watt-hours.

The charging effected with a current at 110 volts will give a work expended of 20 × 110 = 2,200 watt-hours. As the electric current costs 30 cents per kilowatt-hour at Paris, we shall therefore expend 2,200 kilowatts × 1.5 = 3.30, while in principle we had need of utilizing

$$\frac{193.6 \times 100}{2{,}200} = 8.8$$

per cent. of the work expended. The rest will therefore be employed in a lighting circuit; and it will be fortunate for the automobilist if he can do the charging only when he has need of light, or else in a metallic or liquid resistance that becomes heated.

It is expedient to remark that since the driver very often owns a spare battery, he has in most cases only one to be charged, and consequently, for the same type as the preceding, utilizes but from 4 to 5 per cent. of the energy that he expends.

It has been the desire of MM. Legros and Meynier to suppress this great inconvenience in the charging of accumulators by taking a current from a distributing circuit at, say 110 volts,

and transforming it into a current of low voltage. The power, *P*, of an electric current caused by a difference of potential, *U*, and discharging *I* amperes, is connected with these two figures by the relation:

$$P = U\,I \text{ watts.}$$

Having at our disposal any power whatever, we can always keep the same value in watts, by causing *U* and *I* to vary to the same degree. Such variations are obtained through a transformer. MM. Legros and Meynier's apparatus (Figs. 1 and 2) is a rotary or motive transformer with two windings, the primary circuit receiving the continuous current at 110 volts, with a very feeble consumption, and the secondary capable of giving a current of 15 volts with a discharge that is a function of the apparatus' rendering. The winding that receives the current from the distributing main (or, in other words, the primary winding) is an ordinary drum, of which the coils are connected with the contacts of a collector to which the current is led by brushes.

The secondary winding does not give rise to a continuous, but to a direct current. When a spiral closed upon itself is displaced in a magnetic field, the variation in the flow of force produced by such field gives rise to a current that changes direction, that is to say, passes through zero at the moment at which the variation in flow becomes null. At this moment the flow of force is maximum. The electro motive force produced therefore passes through one cycle for one complete circular displacement of the spiral. This cycle is accomplished according to a sinusoidal curve, and we have what is called an "alternating current." If, through an arrangement analogous to that of the Dore commutator, we change the direction of the current in the wiring, at the moment at which it changes poles, we shall have a current that will be always of the same direction, but that will pass through zero. It is a current of this kind that is produced by the Legros and Meynier transformer.

TABLE I.—*Results Obtained with the Transformer Operating as a Motor.*

Difference of Potential in Volts.	Intensity in Amperes.	Angular Velocity in Revolutions per Minute.	Power Furnished in Watts.	Power Collected at the Brake in Watts.	Rendering per Cent.	Observations.
110	0.6	2,400	66	0	0	Empty.
108	1.82	2,200	196.5	142	71	Normal charge.
106	2.6	2,034	276	196	69.5	Supercharge.

Transformer for Charging Accumulators

The motive that led the inventors to adopt it was that it required but a single coil, while in order to have a continuous current it would have been necessary to use several coils, which would have increased the size of the armature, and thus have defeated the object aimed at, which was to have an apparatus as light as possible. From the standpoint of rendering, the result is the same as if the secondary circuit gave a continuous current.

The total weight is 21 pounds. The inductors absorb half of the total current, which is 0.6 of an ampere upon a 110-volt distributing main, with a velocity of 2,400 revolutions a minute, when the apparatus is running empty.

The apparatus in operating as a motor has given the results shown in Table I.

TABLE II.—*Results Obtained with the Transformer in the Operation of Charging.*

Difference of Potential in the Primary in Volts.	Intensity of the Current in the Primary in Amperes.	Angular Velocity in Revolutions per Minute.	Power in the Primary in Watts.	Difference of Potential in the Secondary in Volts.	Intensity in the Secondary in Amperes.	Power in Watts.	Rendering per Cent.	OBSERVATIONS.
112	0.66	2,200	74	15	0	0	0	Empty.
112	1.40	2,200	157	15.5	6	81	51.5	5 elements.
112	1.38	2,200	155	13.5	5.95	80.5	52	5 "
110	2.	2,200	220	10.5	10.25	110.25	50.1	4 "

Table II. gives the results that have been obtained with the apparatus operating for a charging of 5 and 4 elements. The values of the difference of potential of the secondary current were obtained with an alternating current apparatus that gave the difference of the effective potential. The same is the case with the intensity. These two figures are connected with the values of U and I maximum, that is to say, with the values of U and I at the moment at which the curve passes through its maximum, by the relation:

$$U \text{ effective} = \frac{\sqrt{2}}{2} U \text{ maximum.}$$

$$I \text{ effective} = \frac{\sqrt{2}}{2} I \text{ maximum.}$$

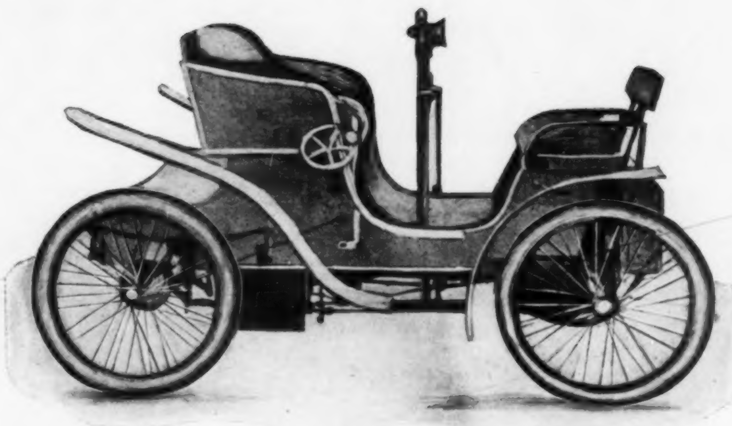
If we refer to the example mentioned in the beginning, we shall see, by observing the proportion, that for a rate of charging of 6 amperes, we have a rendering of about 11 per cent. for 5 elements in using the distributing circuit directly; whence the real saving will be at once seen.

As the apparatus is of limited weight and size, it may be easily placed upon an automobile, and be used on a trip, even though the vehicle has come to a standstill by reason of the failure of the ignition. To this effect, it suffices to actuate the transformer by means of the motor, when the apparatus will operate as a generator, since it becomes excited even at 1,000 revolutions a minute. The accumulator, although discharged, will always give, after a short inoperative period, enough voltage to start up the motor, which at this moment is thrown out of gear. The current is then turned on in such a way that it shall charge the element while it is discharging itself. By regulating the latter in order that it may give the accumulator more than it discharges, a moment will come in which everything will be in a proper state.

Upon furnishing the element with a from 6 to 8 volt current in the secondary circuit, the apparatus will operate as a reversible motor and give a current of from 40 to 50 volts. This may render it interesting for other applications, which, however, do not come within the scope of this journal.

By the addition of two rings to the collector, the apparatus might be made to operate upon the alternating current. To this effect, it would suffice to start it at a velocity such as to allow a connection to take place. Such a velocity would be that of 2,400 revolutions per minute, and would be obtained simply by means of a string wound around the pulley, which would afterwards be made to revolve after the method employed for spinning a top. This is necessary, in order that the phase of the motor shall be identical with that of the current of the distributing circuit. The secondary circuit will always naturally give a direct current.

Upon the whole, this apparatus is capable of rendering very great services to automobilists, who will effect a saving through the use of it. The cost will be quickly covered, and this will count for much in the extension of accumulators for ignition.



The New Decauville Voiturettes

ALTHOUGH, comparatively speaking, it was not very long ago that the first Decauville voiturettes made their appearance, they have already undergone several changes and improvements, and it would require but a few more modifications to convert them into genuine carriages, as, in fact, has recently been done in one case.

One of the new types which has just been brought out, and which is illustrated in Fig. 1, resembles in its general aspect a Decauville voiturette that has already become well known; but in this improved form the entire mechanism is entirely concealed in the carriagework and is thus protected against dust. There was nothing to prevent the adoption of such an arrangement, since, for the former flange-cooled motor of 3 H. P., it had been decided to substitute one of higher power cooled by a circulation of water through the intermedium of a pump and radiator. This new motor, which is of 5 H. P., is provided with two cylinders of 3.2 inch internal diameter.

The vehicle is spring-supported in front and rear—the rear support resembling that employed upon many French railway passenger coaches.

The front wheels are 26 inches in diameter and the hind ones 32.

As alluded to above, the Decauville establishment, going a step further, has brought out a new type of voiturette, which, although very small, may be regarded as a true carriage. This vehicle (Fig. 2), the trials of which are as yet scarcely completed, is driven by an 8 H. P. motor cooled by a circulation of water. It is provided with a gearing that permits of giving it four rates of speed. The motor runs normally at a velocity of 800 revolutions a minute, which is rendered constant by means of a governor. At such velocity, the speed of the carriage may vary all the way from 4¾ to 27 miles an hour. Nevertheless, an accelerator has been provided, so that, should occasion require it, the velocity of the motor may be modified in such a way that any intermediate speed of the carriage can be obtained at will.

The weight of the vehicle, in running order, is but 880 pounds. It is spring-supported at the front and rear, and is mounted upon wheels provided with steel spokes.

As in the voiturettes, the cranks are set at an angle of 180 degrees, so as to prevent vibrations. The transmission is effected solely by gearings, and to the entire exclusion of belts and chains.

The space occupied by the vehicle is very small, say 7¾ × 4½ feet; and yet it is capable of accommodating four passengers.

New Decauville Carriage

The Automobile MAGAZINE

An *Illustrated* Monthly

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Editorial Comment

IT is a matter of great interest that the Automobile Club of America has decided to hold a trade-show of automobiles and automobile accessories next November. The Madison Square Garden has been selected for the scene of the exhibition and special preparations are to be made to fit the great interior for the purpose. The Automobile Club of America is the organization best suited to have such an exhibition in charge and an occasion of great interest may be looked for. But judging by certain features of the programme already announced, we fear that the management has committed itself to procedures which will prove to be somewhat mistaken. We have already expressed ourselves in relation to the desirability of having the occasion an outdoor, rather than an indoor show. The automobile is an outdoor institution, and to be appreciated it needs to be shown in its native element, as it were. To exhibit the automobile indoors is much like having a yachting or boating show, should such forms of entertainment be devised—on dry land!

We note that it is announced that " the interest of the general public will be aroused by the performances of all types of self-propelled vehicles in a circular track in the centre of the Garden. This feature will be relied upon to add life and animation to the show, which otherwise would be a machinery exhibit. Automobiles will do various queer things in the ring, and if all the

suggestions that have been made are carried out an ambulance corps may be needed. There will be a hill climbing contest between automobiles propelled by steam, gasoline and electricity, similar to those given at English shows. Inclined platforms will be provided for these tests, and plenty of amusement is promised by the races up these slopes."

Under the conditions of indoor tests the attributed shortcomings of the gasoline and steam types, such as "odor and noise," even though not appreciable under ordinary circumstances, might be painfully apparent in the motionless air and within the reverberating confines of an interior space. On the other hand, the shortcomings of the electric type are of a nature that they would not be manifest in such a place, and their strong points would show to the best advantage. It would therefore be a great mistake to conduct the exhibition on such lines. The Automobile Club of America is a body above the implication of unfair intentions, and the organization of the first exhibition of the kind in this country on such lines as have been reported could be nothing more than a mistake arising from inexperience. But the effect would be one of discrimination against enormously important branches of the automobile industry. Such a result would be unspeakably unfortunate. It is therefore a matter of the greatest importance to have all the arrangements made upon a basis unquestionably equitable for every interest concerned. "A fair field and no favor" is a motto that must invariably be held in view on all occasions that have to do with industrial competition and emulation, as well as in regard to competition and emulation of every other kind. Therefore it should be understood at the earliest possible moment that no automobile of any type is to be shown in action inside of the building, and that manufacturers should have their vehicles at some suitable outside place ready for demonstration. A study of the Paris exhibition of automobiles will naturally give many excellent hints as to the best manner for conducting the first automobile show on this side of the Atlantic.

Coming Racing Events in France

The last year of the nineteenth century will certainly be a remarkable one for automobile sport. Young as the sport is, it must be admitted that there are not a few automobilists who would not be sorry to see it the last year of racing in that field. For the new vehicles built expressly for the coming great contests will develop such speed as to threaten the security of life

and limb on the part of those who use the highways for the ordinary purposes of transit for which they were intended. The field of interest lies almost wholly in France. The Paris Exposition is chiefly responsible for this great activity. Every day new events loom up in the perspective of the automobile sporting-calendar that has been arranged for the period of the Exposition. Four of these races command attention as events of the greatest importance in their line. The curtain rises, so to say, with the Paris-Bordeaux race, which will be of moment for the French manufacturer and for French automobilists as a demonstration that all the " kings of the road " would have been eligible to contest for the Bennett Cup. This race will also be of note from the fact that foreign automobilists will participate for the first time. At the same time it will be decided what team the Belgian Automobile Club will select for the Bennett-Cup contest.

The second important event, the Bennett-Cup race, will be an international affair. It may be remarked that every one of the clubs participating—the French, the German, the Belgian, the Italian and the American—expect to carry off the trophy!

Three weeks thereafter will come the annual race organized by the Paris daily newspaper, *Le Matin*. This, we think, will be the most interesting of all. Not only the contestants for the Bennett Cup, but many leading automobilists debarred from the Bennett race, will be entered. The last of this great series will come in July, and is called the Race of the Exposition. When these events are over it is more than probable that both the automobilist and the manufacturer will be satisfied.

The itinerary for the Gordon Bennett Cup contest has been prepared. The route will be between Paris and Lyons. The start will be from Versailles at about four o'clock in the morning. The course will be by way of Montargis, Nevers, Moulins, La Palisse and Roanne. Up to La Palisse the grades are gentle and the ways are excellent. From that point there is a descent to Roanne and the route becomes hilly and uneven, traversing the mountain of Beaujolais and Lyon. Taken all in all it is an admirable itinerary for a good race. The average speed is expected to be from 39 to 40 miles an hour.

Beside the foregoing there are the races from Paris to Rheims, from Paris to Boulogne, five or six contests for light vehicles, several exposition contests limited to the tourist class, and others for light and heavy public conveyances. The prizes offered for these various races are considerable. All the racing events are to take place under the auspices and control of the Automobile Club of France.

More About Liquid Air

In the January Automobile Magazine we expressed the opinion that "Liquid Air" had no commercial value, either for power or refrigeration. This condemnation is confirmed by Professor Carl Linde, of Munich, the great authority on heat engines, and himself the inventor of one of the best of liquid air producers. In his lecture at the meeting of the German Naturalists and Physicians at Munich he states: "*If* liquid air cost nothing, and if it could be kept without loss, it would have great value." These "ifs" are the difficulties.

The present largest machines are able to make at the outside limit one pound of liquid air per horse-power hour. We may ultimately attain a production of two pounds per horse-power hour, this being very doubtful, but not absolutely impossible.

In the largest establishments its cost may be reduced to two cents a pound. At this rate the production of cold will cost fifty times as much as in a steam-driven refrigerating machine.

Loss by evaporation may possibly be reduced to about 1% an hour, even a slower rate having been obtained in the Dewar bulbs, which cannot be made of commercial size.

For motors, liquid air can have no value except where cost is no object. It takes six times as much energy to liquify air as the energy obtainable from the liquid air; there are further great losses in any machine, probably 80%, so that only one to two per cent. of the energy spent to liquify can be obtained again as work.

Professor Linde, however, suggests a possible use for liquid air in the gas or oil engine. In these engines the fuel, whether gas or oil, is mixed with air to form a gas which, by explosion, drives a piston. There are two drawbacks to these engines:

First—The heat of the explosion is very high, between 2,500 and 3,000 degrees, and to prevent the cylinder heating red, or even white, it is water jacketed and the heat lead off. This jacketing carries off from 30% to 50% of the energy without an equivalent in useful work.

Second—While steam engines receive an impulse every half turn of the flywheel, gas or oil engines receive an impulse every two turns. The first stroke is that of impulse or explosion, the second of expulsion of burnt gases, the third of indraft of fresh charge, the fourth of compression of the charge. Owing to the extreme heat and high pressures only one side of the piston is usually used. As a consequence gas and oil engines, although

economical of fuel, are very heavy and require one or two heavy flywheels to secure even motion.

If, instead of air, a few drops of liquid air were injected into the cylinder, together with the required oil, combustion at lowest possible temperature could be obtained and the water jacket losses would be minimized, and both sides of the piston could be used and a charge of liquid air and oil injected at every stroke.

Such a heat motor could probably be made more powerful for its weight and for fuel consumption than any motor ever built, and it would therefore have great value in certain automobile or other small motor work.

Cost must, however, be considered. A pound of oil costing one cent a pound requires for its combustion about 18 pounds of liquid air costing a minimum of two cents a pound, and therefore, aside from the difficulty of either securing or keeping a supply of liquid air, the operating costs of such an engine, which is not a liquid air engine but an oil engine, will be 36 times as great as the cost of an engine using atmospheric air.

Professor Linde sees no hope for the commercial use of liquid air, either for power, refrigeration or explosives, but thinks it may have value in surgery or to obtain an air rich in oxygen for certain chemical operations. The latter is at present the only probable field for its use on a commercial scale.

The Question of Design

A fault that is found with the appearance of the automobile lies in the universal tendency to embody in a new thing the aspect of some familiar thing nearest akin thereto. One of the most conspicuous examples of this tendency is exhibited in the extraordinarily close manner in which the design of the stage-coach was followed in the railway carriages of Europe. An American who visits Europe for the first time is astonished to see how the lines and the detailed features of the stage-coach are imitated in the passenger-cars of railways everywhere. These cars were originally designed to resemble as closely as possible the pattern originally furnished in the first of such cars, which were composed simply of several stage-coach bodies secured to a platform that was mounted on wheels. And the type, awkward and inconvenient as it is, has persisted to this day. Without the slightest use, and in a manner that contradicts natural lines, the aim still is to produce the effect of a composite stage-coach. The doors and the windows are the same, the seats are the same, and in

the interior various stage-coach details are retained that do not have the slightest relation to a railway-carriage. Other details remain in a rudimentary form. For instance, it is not uncommon to see included in the fittings, simply for ornamental effect, straps such as stage-coach passengers were wont to cling to when traveling a jolting road. The American type of passenger-car, however, is such a complete departure from the stage-coach prototype, that it demonstrates that the unreasoning following of a model purposed for a quite different form of use is not inevitable. But when we consider that the first passenger-cars in this country were constructed after English patterns it seems remarkable that the change should ever have been made to something so radically different, and so thoroughly in conformity with natural requirements. It gives hope, however, that correspondingly independent lines will ultimately be followed in the development of the automobile in this country.

The common remark that the automobile looks too much like a carriage going about without a horse has much to justify it, and it indicates a radical defect in design. The carriage for animal-traction was designed to go with the horse, and in the correctly designed automobile the absence of the horse should not be felt. Every person with a true sense of beauty—and therefore a sense of proportion in animals according to the nature of a given species—knows how abominably a horse looks with his tail docked, as demanded by absurd standards of fashion. The proportion as to length is radically changed and the consequence is that the absence of the tail gives the animal an abnormal effect of abbreviation, a kangaroo-like awkwardness. It is such a sense of abbreviation that one is apt to feel in the average automobile design. Horse and carriage were a unity, and simply to make a carriage as before gives the impression of a broken unity. The problem should be considered by artistic designers in the light of only existing factors, forgetting entirely the factors that have ceased to exist. If a good designer could be found who had never seen a horse and carriage and the requirements of the case should be placed before him we should be likely to secure a most admirable design, thoroughly expressive of the purpose and nature of the vehicle. As it is, designers will have to divorce their minds from the old associations of the carriage as they have known it. For this reason better results may be looked for from designers that have not been connected with the designing of ordinary carriages. The writer once saw a capital design for an automobile sketched by Mr. Frederic E. Church, the eminent painter, who possesses native mechanical ability to an excep-

tional degree. It met in a sensibly graceful and artistic manner the practical requirements of the problem.

In considering what should be the proper conditions for automobile design it should be remembered, for instance, that unlike a carriage for horses there is no longer need to sit high to avoid dust and mud from the feet of animals. With a low base comes a better centre of gravity and greater safety. Neither is it essential, in the case of a coachman, for that individual to sit in front and obstruct the view, as was necessary when he had to look after his horses. Flat surfaces in front should also be avoided. Every wheelman knows how hard it is to go in the face of the wind. A flat surface with a head wind therefore means a great waste of power for an automobile, a waste that would be avoided by making the front as sharp as practicable. Great improvements have been made in recent automobile designs and we already have not a few handsome-looking vehicles. The Draulette Electromobile, for example, illustrated in our March number, has a notably graceful and appropriate design. It should also be remembered that it takes some time before an adopted design can be realized in the output of the great manufacturing establishments. For instance, types of vehicles that were designed three years ago are now just making their appearance in public, and the art has naturally made great advances since that day. From what has already been accomplished in the way of improved design there is reason to hope that results will be reached as felicitous in the way of separating the shape of the automobile from unavailing precedents as those achieved in the case of the railway coach in this country.

A Mobile Exhibition

The projected grand tour of the Automobile Club of Great Britain arranged for the coming summer is to be an affair of unusual interest. A round trip is to be made on a great scale throughout England and Scotland, visiting all the leading cities. And in each city a feature will be made of holding a sort of informal exhibition, showing the vehicles to the public in ways that cannot fail to be both interesting and instructive. This is an example which, of course, cannot possibly be followed in this country in its entirety. In the first place, our national domain is too extensive to make it practicable. In the second place, we have not the roads that would admit of a tour of the kind in any section of this country, even as circumscribed as the Island of Great Britain. Yet it furnishes suggestions for something of the sort

on a more limited scale, and the idea ought to be followed in the near future. Certain parts of the country are already famed for fine roads. In the States of Massachusetts and New Jersey, for instance, there are so many excellent roads that in each of those sections it would be easy to arrange such a tour. It would not only be for the participators an immensely enjoyable occasion, it would be an occasion of enormous popular interest. In every leading place visited the coming of the automobiles would be the event of the week—even of the season, we might say. It would be an occasion for novel festivities. Notable hospitalities would be shown, the public would be immensely interested and would be familiarized with the new form of locomotion, for which friends would be made everywhere. Hardly anything would be better calculated to demonstrate the utilities and the pleasures of the automobile, and its serviceability for the community. It should be a comparatively easy matter to organize such a tour in a manner that would make it an occasion memorable for pleasure and comfortable travel from beginning to end. A beginning might be made this year in both of the States mentioned, and likewise in other sections of the country where conditions are favorable. And once the beginning made, the tour would be likely to become an annual event—increasingly with each successive year one of the great occasions of the summer. In fact, it would be an automobile exhibition of the most appropriate kind—a traveling exhibition, a mobile show, true to its name and nature.

Automobile Highway

Once more the plan of a national highway from the Atlantic to the Pacific has been revived, this time by owners of automobiles. The Automobile Club of America is taking active steps to popularize the movement for a good road from sea to sea.

A commission of enthusiastic automobilists has been appointed, among its members being Gen. Nelson A. Miles, Col. Peter S. Mitchie and Prof. Samuel E. Tillman, of the United States Military Academy, and Major Richard L. Soxie, of the Engineer Corps, U. S. A. This commission held its first meeting at the Waldorf-Astoria April 2, and the movement was formally launched at a dinner in honor of Gen. Miles.

Among the invited speakers were Gen. Roy Stone, head of the Department of Road Inquiry, under the Department of Agriculture, who has expressed his sympathy with the movement.

Automobilists intend that the highway shall be built independent of existing roads and the expense borne by the United States, aided by States through which the road will pass.

A Chance for Heavyweights

We have received the following letter from the American Consulate at St. Petersburg:

"Will the Automobile Magazine be kind enough to notify the manufacturers of automobile freight wagons that the Russian Minister of War proposes that if any manufacturer ship to him care of Colonel N. A. Blinoff, Chief Staff, Ministry of War, St. Petersburg, Russia, two such machines, one to be propelled by steam and the other by kerosene, he will pay the freight and duty on both, purchase the one best suited and return the other. The machines to be in St. Petersburg by June, 1900.

"Manufactures will please mail catalogues to Colonel Blonoff, giving price, weight, inside dimensions, rapidity of movement and other data.

"This is a great opportunity to furnish the Russian Army with wagons and will lead to a large business.

Very respectfully,

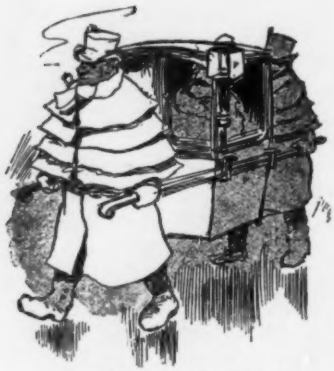
W. R. Holloway,

Consul-General."

A similar request has been forwarded to us by Prof. R. H. Thurston, of Cornell University. This letter came from M. C. Burch, of the Department of Justice, in Washington, D. C.:

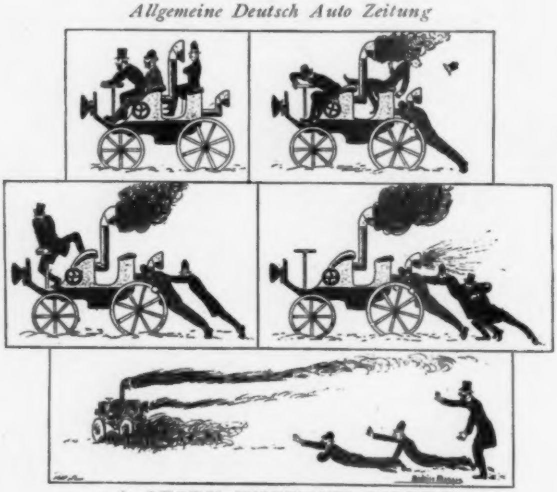
"My attention has been attracted to Prof. Thurston's article in January number of the Automobile Magazine. I am much interested in a study of mechanical methods for transportation of ores and other heavy but not bulky freights in the arid regions of the West. While I would prefer oil motors, I would not hesitate to adopt another kind if under all the circumstances it seemed desirable. I would be greatly obliged if you would send me any catalogues, circulars or other data you may be able to spare that would assist me."

The United States Consul at Batavia writes about the prospects of automobilism in Java as follows: "This is the very finest kind of a country for automobiles, as the roads are good, and, owing to the bad climate, the wear and tear on horseflesh is very great. At present there are only two in the island—of what make I do not know. I am convinced that it would pay to introduce them. Power is cheap here, and water is abundant, and fuel and labor reasonable in price."

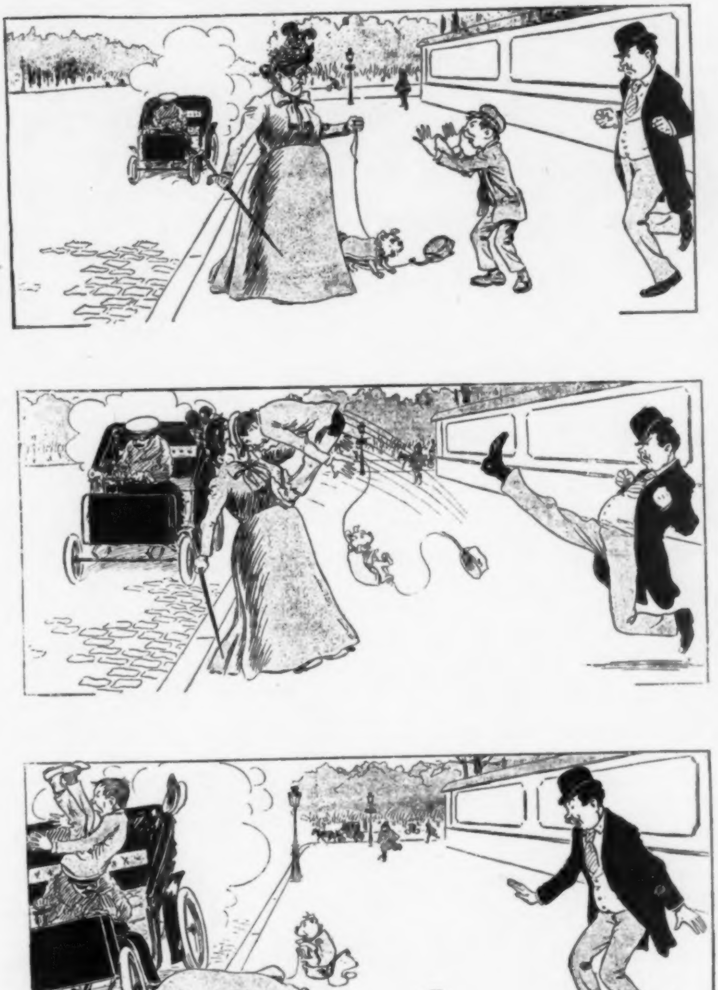


A Horseless Carriage

Types of German Schnauferlmen
Allgemeine Deutsch Auto Zeitung



A STORY WITHOUT WORDS
From *Le Monde Illustré*



THE MOTHER-IN-LAW AVENGED

FALCO in *L'Univers Illustre*

The Automobile Index

Everything of permanent value published in the technical press of the world devoted to any branch of automobile industry will be found indexed in this department. Whenever it is possible a descriptive summary indicating the character and purpose of the leading articles of current automobile literature will be given, with the titles and dates of the publications.

Accumulators—

A serial article, by E. C. Rimington, on the construction and management of electric accumulators for automobiles. With illustrations. "The Automotor Journal," London, February, 1900.

A technical article by Prof. Félicien Michotte. "The Automobile Magazine," March, 1900.

Advantages of Multi-cylinder Motors—

An article on the respective merits of two, three and four cylinder gasoline engines of various types. "The Motor Age," Chicago, February 8, 1900.

An Automobile for Land and Water—

A descriptive notice. "The Automobile Magazine," March, 1900.

A Typical French Voiturette—

An illustrated description. "The Automobile Magazine," March, 1900.

Automobile Management—

A serial article, by Philauto, giving practical hints to users of automobiles. "The Motor-car World," London, February, 1900.

Automobiles and their Construction in the United States—

An article and illustrations relating to this subject. "The Carriage Monthly," Philadelphia, Pa., February, 1900.

Automobiles and their Motors—

A serial technical article. With illustrations. "L'Industrie Automobile," Paris February 25, 1900.

Automobile Tariffs—

(Some of the foreign tariffs compared.) "The Automobile Magazine," March, 1900.

Boilers for Steam Automobiles—

Description of the Toward water tube boilers for steam automobiles. With five illustrations. "The Autocar," Coventry, England, February 3. 1900.

Brakes—

Description and illustration of a special brake for automobiles, devised by M. E. Berteau. "La Locomotion Automobile," Paris, February 1, 1900.

Carbureters—

Illustrated description of a new carbureter devised and patented by Charles Le Blon. "La France Automobile," Paris, January 7, 1900.

The Goutallier carbureter described and illustrated. "Les Petites Annales Illustrées du Cycle et de l'Automobile," Paris, January 13, 1900.

Peugeot's carbureter described and illustrated. "L'Industrie Automobile," Paris, January 25, 1900.

The Lepape carbureter described and illustrated. "La France Automobile," Paris, January 25, 1900.

Illustrated description of the Aster carburer. "La Locomotion Automobile," Paris, January 25, 1900.

Illustrated description of both the Le Blon and the Abeille carbureters. "The Automotor Journal," London, February, 1900.

The Automobile Index

Description of the Parsons carbureter, with one illustration. "The Automotor Journal," London, February, 1900, also "La Locomotion Automobile," February 22, 1900.

The new Raymond carbureter described and illustrated. "The Motor-Car Journal," London, February 9, 1900.

Illustrated description of the Lempriere combined inlet valve and carbureter. "La Locomotion Automobile," Paris, February 22, 1900.

Cooler and Starter—

The Estcourt cooler and starter described, with two illustrations. "The Autocar," Coventry, England, March 3, 1900.

Electric Automobiles—

Full description of the Pieper carriage, with illustrations. The propulsion of this vehicle is effected by a novel combination of electric power and a gasoline motor. "Les Petites Annales Illustrées du Cycle et de l'Automobile," Paris, January 7, 1900.

Description, with illustrations, of the E. C. Stearns & Co.'s carriage. "Electrical World and Engineer," New York, January 27, 1900.

Description and illustration of a new electric carriage, designed by Mr. W. H. Chapman, of Portland, Me. "The Motor Vehicle Review," Cleveland, O., January 30, 1900.

Description of the Scheele carriages. With three illustrations. "The Motor-car Journal," London, February 2, 1900.

"European types of electric automobiles." An illustrated description of the Henschel, the Lohner, and the Piper carriages; also of other vehicles. "Electrical World and Engineer," New York, February 10, 1900.

The Chapman light weight storage battery automobile fully described. With three illustrations. "Electr cal World and Engineer," New York, February 17, 1900.

The Draulette electromobile described and illustrated. "The Automobile Magazine," March, 1900.

An enclosed automobile for doctors, designed by Elmer A. Sperry and built by the Cleveland Machine Screw Company. A brief description. With one illustration. "Electrical World and Engineer," New York, March 3, 1900.

"Trolley-fed Automobiles in France." A descriptive and illustrated article about the trolley-fed automobile system that is now being experimented with near Paris. The inventor is Mr. Lombard-Gerin. "Electrical World and Engineer," New York, March 10, 1900.

Electric Ignition—

A comparative study of various American devices for electric ignition. "The Horseless Age," New York, February 7, 1900.

Electric Motors—

The Chapman electric motor and outfit for automobiles, which can be attached to any carriage. Its description and illustration. "Cycle and Automobile Trade Journal," Philadelphia, March, 1900.

"The calculation of the capacity of Batteries and Motors for Motor Vehicles." Suggestions and formulæ for said calculation. "The Hub," New York, March, 1900.

A technical article, by P. M. Heldt, under the title of "Motors for Electric Automobiles." With one illustration. "Electrical World and Engineer," New York, March 10, 1900.

Electric Truck—

Description and illustration of an electric truck for delivering pianos, built by the Woods Motor Vehicle Company of Chicago. "The Motor Vehicle Review," Cleveland, O., February 13, 1900.

Elementary Instruction About Electric Automobiles—

A serial article by J. M. Davis. "La France Automobile," Paris, February 25, 1900.

Fore-carriage—

Illustrated description of the Vollmer detachable fore-carriage for automobiles. "Scientific American," New York, February 10, 1900.

Gallery of American Automobiles—

(Exposition carriages.) "The Automobile Magazine," March, 1900.

Hot Tube Versus Electric Ignition—

A technical article, by Herbert L. Towle. "The Horseless Age," New York, February 28, 1900.

Hydro-carbon Automobiles—

A brief description of the Gladiator voiturette. With one illustration. "La France Automobile," Paris, January 18, 1900.

André Py's voiturette described. With five illustrations. By Paul Sarrey. "La Locomotion Automobile," Paris, January 18, 1900.

The Chesnay carriage briefly described. One illustration. "La France Automobile," Paris, January 21, 1900.

A full description of the various parts of the Peugeot carriage. With illustrations. "The Motor Vehicle Review," Cleveland, O., January 23, 1900.

"The Construction of a Gasoline Motor Vehicle." An article. With illustrations, by Clarence C. Bramwell. "The Motor Vehicle Review," Cleveland, O., January 23, 1900.

A full description, with four illustrations, of the Delahaye carriage. "La France Automobile," Paris. January 25, 1900.

Illustrated description of a new gasoline truck built by Amédée Bollée Fils. "Le Chauffeur," Paris, January 25, 1900.

A brief description of the Vinet voiturette. With one illustration. "Le Chauffeur," Paris, January 25, 1900.

The Clément carriage described and illustrated. "Le Chauffeur," Paris, January 25, 1900.

The Cochot light vehicles briefly described. With two illustrations. "The Motor-Car Journal," London, January 26, 1900.

Description of the "Balmoral" gasoline "char-à-banc." With one illustration. "The Motor-Car Journal," London, January 26, 1900.

Illustrated description of the Tourand Automobile. "La France Automobile," Paris, January 28, 1900.

Full description of the Morisse voiturette, as built by E. J. Brierre & Cie. With three illustrations. "L'Avenir de l'Automobile et du Cycle," Paris, February, 1900.

The Gobron and Brillié Automobiles fully described by G. Chanveau. With illustrations. "The Automobile Magazine," February, 1900.

Illustrated description of the "New Orleans" carriage, built at the New Orleans Works, in Twickenham, England. "The Autocar," Coventry, England, February 3, 1900.

The latest two and four-seated Leach carriages described and illustrated. "The Motor Vehicle Review," Cleveland, O., February 6, 1900.

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